

# **NUTS & VOLTS**

MAGAZINE



\$3.50

VOL. 18 NO. 11  
NOVEMBER 1997

*Exploring Electronics And Technology For The Hobbyist And Professional*



Build the  
**AK-210 Talking  
Alarm Clock**



**AUDIO EDIT FEATURE.**

*Allows you to select and copy Audio CDs, track-by-track, or disc-at-once, to create custom Audio CDs.*

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- Includes driver disks, photocopied book
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- We had these and ran out...New stock at Lower Price!

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- New in OEM package (no box), 90-day HSC warranty
- Includes driver disks, photocopied book

HSC#17028 \$13.95

- Media Vision PCMCIA 16-Bit Sound Card
- Great for Portables, Laptops with PCMCIA Slot
- External Pod has Joystick Port, Mic. input, Line In & Line Out jacks, Volume control.
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- New in OEM packaging (no box), 90-day HSC warranty
- We had these before at \$39.95 and they went fast!

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- Relisys Model HS410G 256 Grayscale Hand Scanner
- Up to 800 dpi (dithered) resolution available
- Brand new OEM pack (styrofoam tray)
- Includes manual, interface card, diskette with TWAIN drivers
- Note: Previous ads in error...no application software is included!
- New, 90 day warranty -- unit is similar to illustration

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### Absolute Last of the Red Hot Reno!

- Now at clearance price -- Media Vision Reno:
- Consists of new external Reno CD-ROM drive, docking bay with SCSI2 port, AC Adapter, cable kit, travel pouch, headphones
- Late Model version Uses AC adapter (included) or AA alkaline batteries (not included)
- Double-speed 180mS drive is lightning fast!
- Drive detaches from docking bay, use with headphones as a portable personal audio CD player
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- Mac software included
- SCSI Controller & software required for IBM use
- Brand new, 90-day warranty

Now -  
**\$59.00**



Available Separately:  
A. Macintosh Powerbook SCSI Adapter (HD-30 to 25-pin D connector) HSC#15704 \$12.50 if purchased alone, or with purchase of Reno Kit,\$5.00

### Drive-bay Speakers!

- Save desk space, eliminate tangled wires!
- Twin-sound by Sound Minds installs in any 5.25" drive bay
- Built-in 4-watt amplifiers punch up sound
- Compatible with any sound card
- Independent volume controls for left & right speaker
- Front-mounted jacks for microphone, headphones

HSC#16277 \$14.95



### Stereo Keyboard!

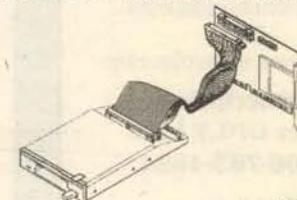
- Multimedia Stereo Keyboard by SC&T International
- Built-in high power stereo speakers & amplifier
- Full range 4" bass enhanced, hi-fidelity 16 watt speakers
- Works with all sound cards & CD-ROM drives
- Or use with portable radio, cassette or CD player
- Separate Volume, Bass, Treble & Balance slide controls
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- Built-in omnidirectional microphone, plus mic. jack
- Headphone jack for private listening (headphones incl.)
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HSC#17027 \$37.50

### Son of SwapBox!

- Just in time...we ran out of the regular SwapBoxes!
- IBM Compatible Reader/Writer for PCMCIA Cards with built-in 1.44 MB Floppy drive...fits in standard floppy bay!
- SwapBox Combo by SCM Microsystems for ISA bus
- Convenient front access for slots (not in rear of system)
- Dual slot, Type I, II or III, hot swappable
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- Directly supported by Windows 95 - no drivers needed!
- Includes DOS driver disk, manuals, cable, internal card
- New in OEM package (white box), 90-day warranty



HSC#16819 \$99.95

### Joystick Extravaganza!

- Back in stock -- joysticks for computer games!
- Suncorn FX-2000, new in box, unbelievable value!
- Form fitting joysticks work with either hand
- Suction-cup feet anchor them for lightning fast action!
- New in box - 30 day warranty
- Hurry, they went fast last time we had them!

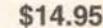
HSC#17008 Suncorn FX-2000 Joystick \$4.95



### Low Price, High Quality!

- Superior quality in a PS-2 compatible keyboard!
- Hewlett Packard part #A2840-60207
- 102-key keyboard has standard QWERTY layout with additional French characters
- PS/2 style connector (mini-DIN)
- New in box, 90-day warranty
- Similar to Illustration

HSC#17030 \$14.95



### Phone Voice Scrambler

- Privacy at the push of a button -- SecureTalk by GRE!
- Advanced circuitry encrypts telephone conversations from casual eavesdropping, including scanners!
- Small, portable units operate off AC adapter (Land-line model) or cigarette lighter plug (Cellular model).
- Measures 7" x 4" x 1.5", operates on 9-12 VDC
- Provides a choice of 32 different scrambling codes over 4 channels. Can be bypassed by pressing "Normal" button.
- Sold in pairs, choose AC operation, mobile, or one of each.
- Unit inserts between handset and base of phone (Note, will not work with slim-line or other all-in-one-piece phones!)
- Unit has DB-9 connectors, you will need to fabricate an adapter cable set (DB-9 male & female to mini-modular connectors, diagram provided, ask about parts kit for land-line unit)
- Both styles are identical except for power adapter and one jumper.
- Units are new in box, 90-day warranty - exchange



HSC#16909 Land-Line Phone Scrambler

HSC#16910 Cellular Phone Scrambler

Your Choice - any two, any style for \$29.95/pr.

### PCI Video Accelerator Cards from Media Vision!

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- Win95, NT & 3.1 drivers and full manual on CD-ROM
- If you can not read CD's, diskettes are available, \$2 extra
- New in box and have a 90-day HSC Warranty

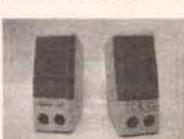
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### Super Sounding Speakers!

Tired of the cheesy sound coming from those give-away speakers in your multimedia kit? Try upgrading to these sonic wonders...you'll have to hear them to appreciate the difference these will make without blowing your budget!

- GNT2002 2-way Bass-Reflex speakers
- 3.25" woofer, 1" piezo tweeter, ported enclosure
- 15W built-in amplifiers, 80W peak, 5.4W RMS
- 40 - 20,000 Hz, built-in SRS 3-D stereo
- Measure approx. 3.75" x 6.125" x 9.25" tall
- AC adaptor, audio cables included
- On-off switch, 3-D switch, bass, treble & volume controls
- Attractive off-white finish with grey grille-cloth

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- GNT3500 3-way Bass-Reflex speakers
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- AC adaptor, audio cables included
- On-off switch, 3-D switch, bass, treble & volume controls
- Attractive off-white finish with grey grille-cloth

HSC#16671 \$39.95



### SCSI Device Cases

- Horizontal style case, 9.5" x 2.5" x 10.5", 30 watt power supply, fan cooled, room for 5.25" drive, front access
- HSC#16185 \$29.95
- Upright Case, 3.5" x 5.5" x 8.125", has front opening for 3.5" drive, 20 watt power supply, no fan
- HSC#16559 \$49.95

- Deluxe quality case, 7" x 4.5" x 10.75", made for Olympus Optical, has 5.25" open front bay, SCSI diagnostic indicator on rear panel, 30 watt fan-cooled power supply, IEC power cord included. Assembled in USA.
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Nuts & Volts Magazine encourages article submissions and queries. Send a SASE for a copy of our writer's guidelines.

All submissions should be on 5-1/4 or 3-1/2 inch diskettes and include hard copy as well. If return of materials is requested, include a SASE with your submission.

Deadlines should be discussed in advance with the editor, but generally all material should be submitted by the 1st of the month for the next month's issue.

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# reader feedBack

### Correction for "Build the LAB" (Oct '97) by Larry Ball

Between the time "Build the LAB" was written and the time it appeared in the Oct. '97 issue, the variable capacitor mentioned in the article (Mouser and DC Electronics Part #24TR218) was discontinued by the manufacturer. I apologize for any problems this may have caused the readers of *Nuts & Volts Magazine*. Fortunately, there are alternatives.

**Fair Radio Sales** (1016 E. Eureka St., P.O. Box 1105, Lima, OH 45802, **419-223-2196**) sells a 12 pF to 475 pF variable capacitor which will work as a replacement. It's part #C123/URM25. The correct leads for this capacitor are the top solder terminal and the case.

**Antique Electronic Supply** (6221 S. Maple Ave., Tempe, AZ 85283, **602-820-5411**) sells a 15 pF to 500 pF (three section) variable capacitor which will also work. Their part number is #C-V500-X3. When connecting this capacitor, use any one of the six circular loops as one lead, and the case as the other lead. All of these capacitors are much larger than the original capacitor, and will require a larger enclosure

than the LAB prototype. Their price is around \$10.00 plus shipping.

Again, I apologize for any problems this may have caused.

Larry Ball

### Corrections for "Digital Voltmeter Capacitance Adapter" (Sept '97) by Fred Blechman

Several words in the final paragraph were left out. It should read:

*The two switch knobs fit through round holes in one end of the box, and the unknown capacitor terminal mounts on the top.*

Also, the paragraph at the top of page 62 should read:

*Capacitors are inherently AC devices, since they block DC current flow once they are charged, and the amount of AC current they pass increases as AC frequency increases.*

Due to unforeseen circumstances, Part 3 of "Encyclopedia of Electronic Circuits" by TJ Byers, had to be rescheduled until next month. Sorry for any inconvenience this may cause.

Editor

Continued on page 93

# EPROM+

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Rave Review  
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April '96

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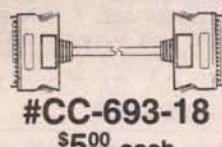
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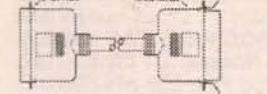
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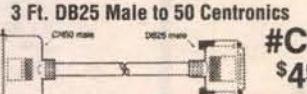
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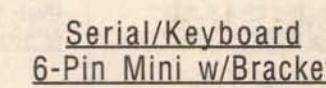
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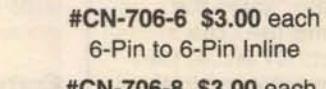
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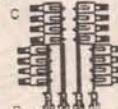


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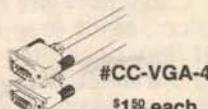
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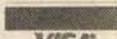
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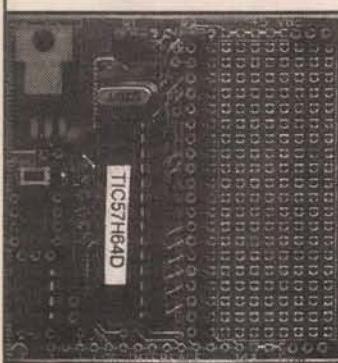
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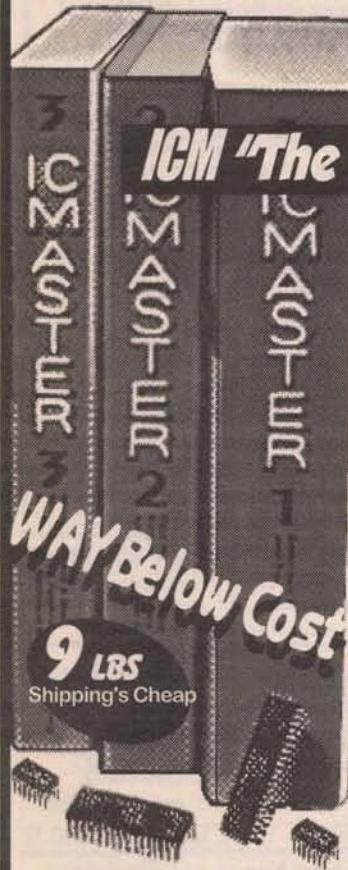
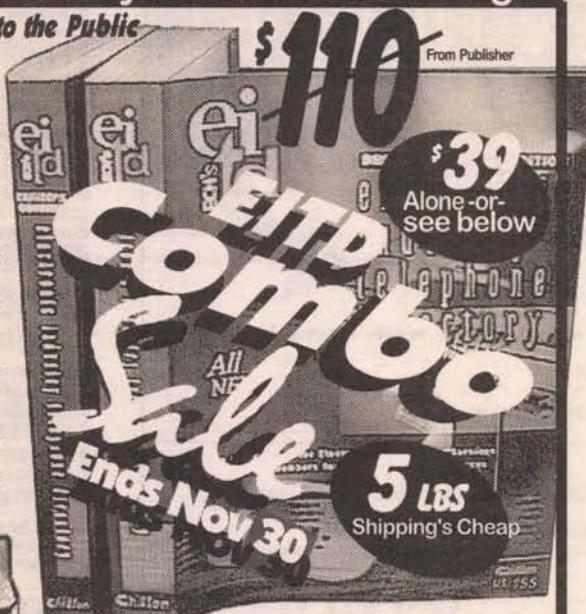
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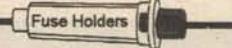
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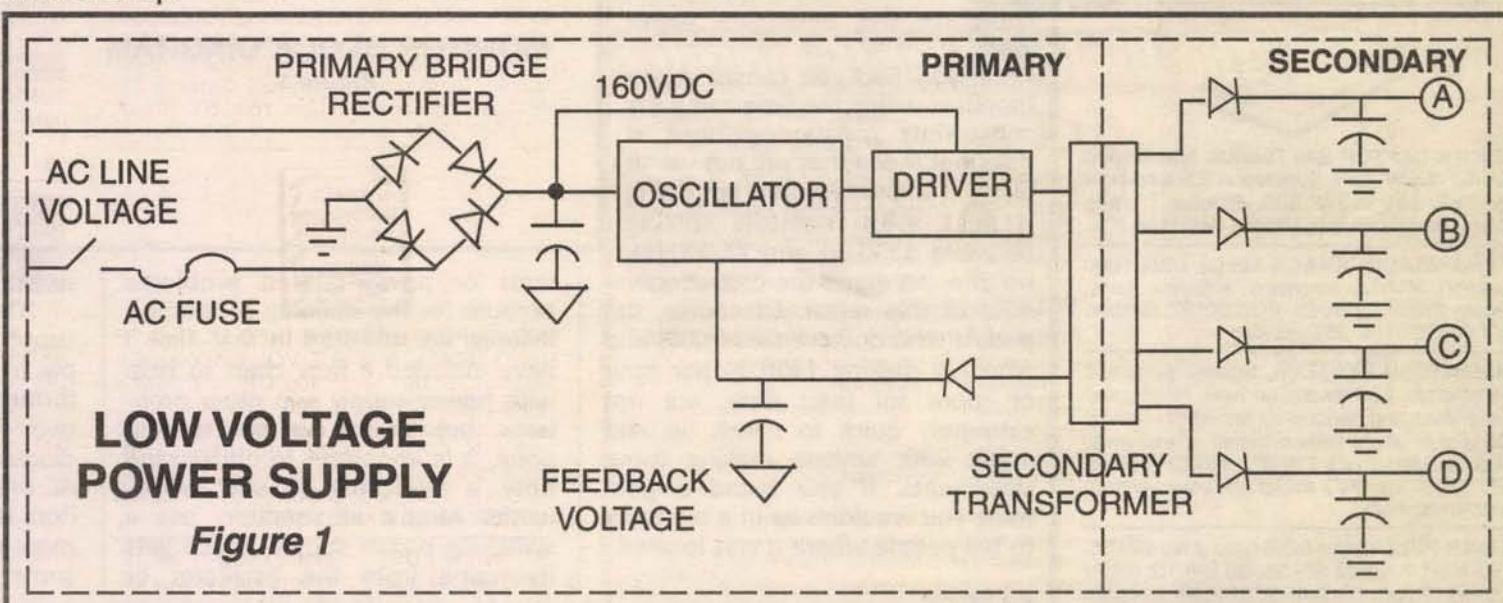
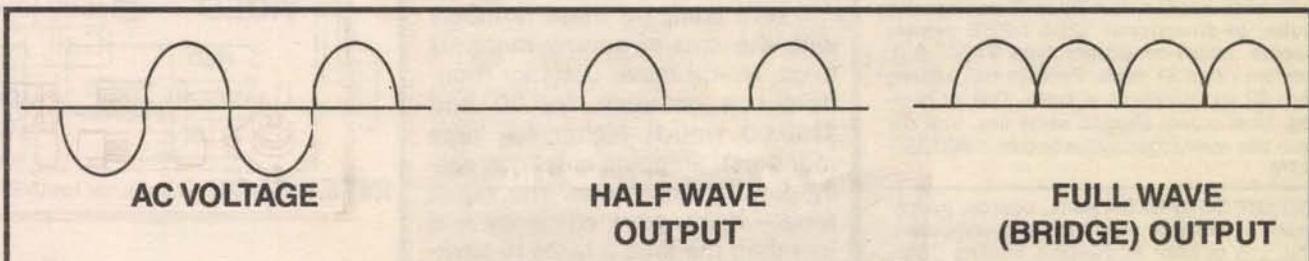
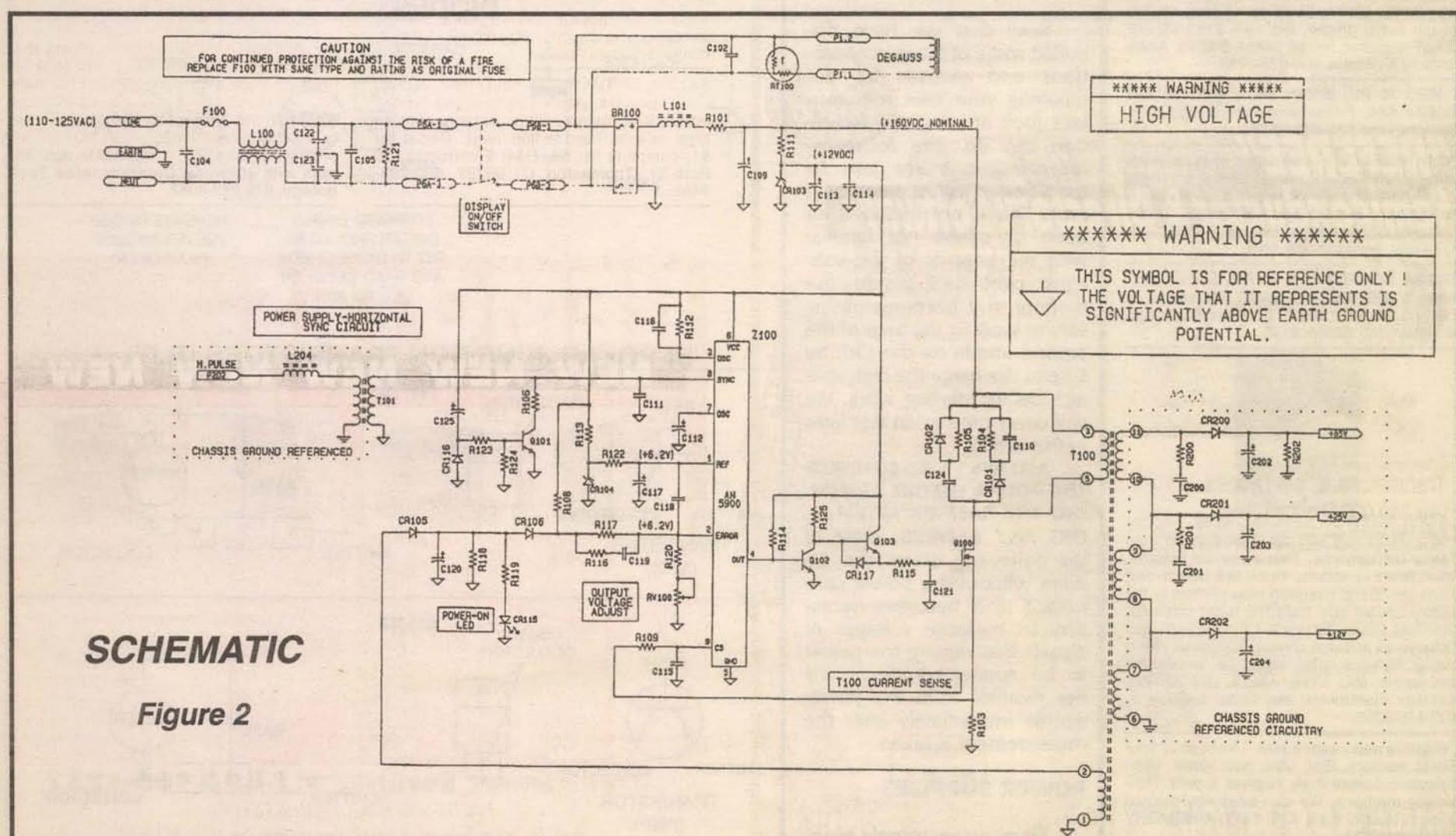


Figure 1



SCHEMATIC

Figure 2

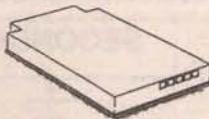
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could spend thousands on fancy test equipment, the most efficient equipment is also the least expensive. For example, starting from scratch, you can buy everything you need at a cost of under \$700.00, and you would be well equipped (see list of equipment at the end of this article). If you wanted to cut some corners, you could get started for about half that number.

Let's compare these numbers with the cost of getting monitors fixed. Typical repair costs for monitors run between \$65.00 and \$150.00 (much higher for large monitors). Shipping costs can easily double these costs. The repair time — if you work efficiently — is less than the time it takes to package the monitor for shipping and complete the necessary paperwork.

If you find you cannot repair monitors within the time and parts constraints mentioned here, it does not mean they are not worth fixing, it means you are not doing it right. With monitors costing between \$200.00 and \$3,000.00, no one can argue the cost-effectiveness of this repair. Of course, the people who do have these skills and who are making \$300.00 per hour or more for their time, are not extremely quick to speak up and argue with anyone making these statements. If you found a gold mine you wouldn't be in a big hurry to tell people where it was located.

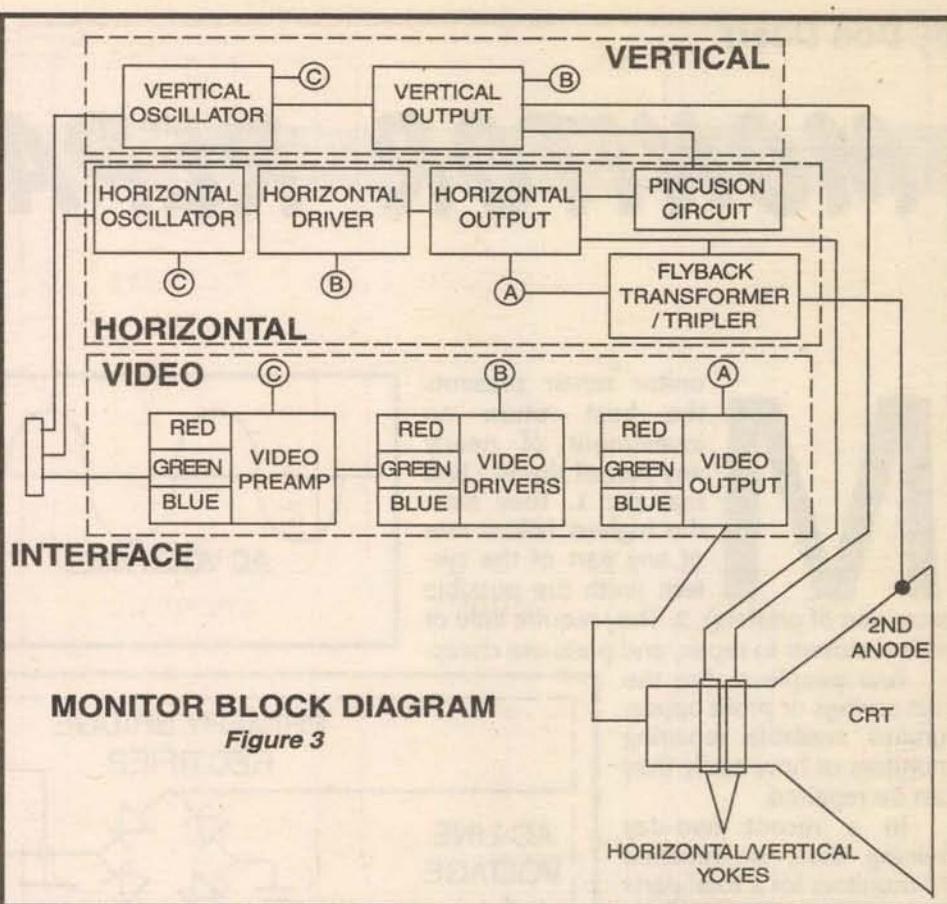
## SAFETY

Now that we have dispelled some of the misconceptions and excuses for not repairing your own monitors, let's look at what the technician can do. **The following information is for use by qualified service personnel only.** This is not intended for users or others not familiar with the hazards of the voltages contained inside the monitor. If it becomes necessary to work in the area of the second anode on the CRT, be sure to discharge the high voltage before starting work. We will cover how to do this later in this article.

**ALWAYS DISCONNECT THE POWER BEFORE REMOVING THE CASE OR ATTEMPTING ANY REPAIRS.** Most of the following steps can be done without the power connected. If it becomes necessary to measure voltages or signals that require the power to be connected, disconnect the monitor from the power source immediately after the measurement is taken.

## POWER SUPPLIES

Since power supply prob-



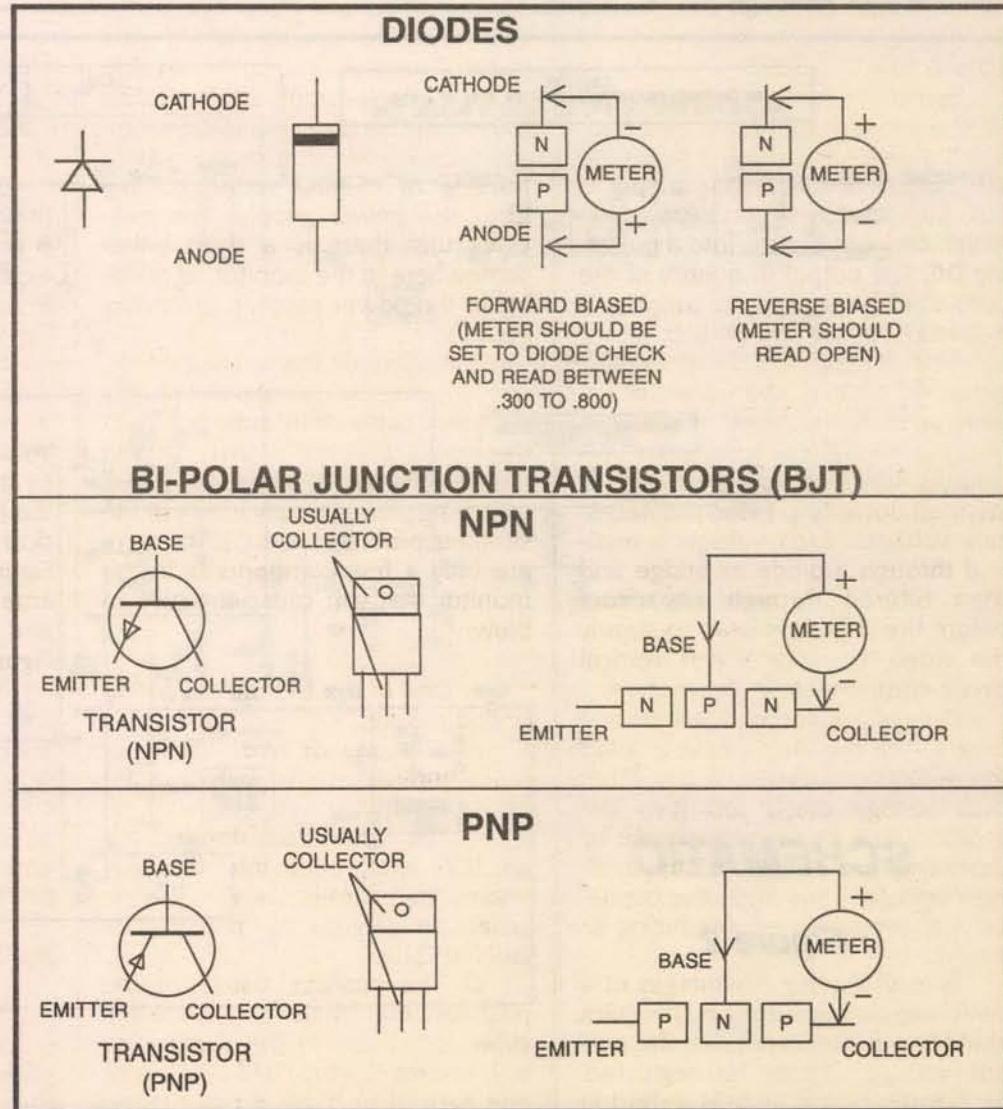
MONITOR BLOCK DIAGRAM

Figure 3

lems or power-related problems account for the majority of monitor failures, we will start in that area. I have included a flow chart to help with power supply and other problems, but before we get to that point, it is important to understand how a switching power supply works. Almost all monitors use a switching power supply, which gets its name from the oscillator or

switcher circuit (see Figure 1).

The most basic type of power supply is called a linear power supply. In a linear supply, the AC is fed through either a halfwave (one or two diodes) or a fullwave (four diodes) rectifier, which converts the AC into a pulsating DC. Filter capacitors are used to make the voltage a more steady DC voltage, and usually some type of silicon regulator will





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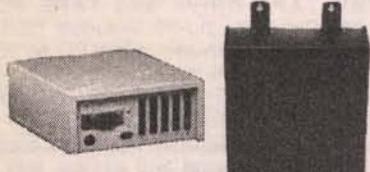


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have an internal vertical and horizontal oscillator. The vertical and horizontal signals from the system are used to sync up the display with the incoming signals. Most newer monitors have energy-saving modes called a standby mode.

If the monitor does not sense a horizontal signal on the signal cable, they will shutdown the high voltage and the CRT heater voltages in order to save energy. This is why you must always use an input signal when testing monitors.

In Figure 3, it becomes obvious that most of the circuits in the monitor are simply used to amplify the signals from the system in order to supply the necessary drive required by the CRT.

## INTERFACE AND VIDEO

The most common problems that could be associated with either of these sections would be, for example, incorrect colors due to a bad cable, bad video driver chip/transistor, or a bad connection. Other common problems relating to bad interface cables include no display, monitor errors (2401) on POST, inability of the monitor to properly sync vertically or horizontally, or a dim screen. For any of these problems, first check for bent or broken pins on the connector. Next check for a bad cable by wiggling the cable and watching for changes on the screen, and then use an ohmmeter to prove continuity on all connections. Check for bad connections on the board located on the back of the CRT, before looking for failing transistors or capacitors in this circuit.

## HORIZONTAL AND VERTICAL

Many of the following problems that can occur with the horizontal and vertical circuits can be corrected with the adjustments either on the front or back of the monitor. For some monitors, the case will have to be removed to get to these adjustments. Always mark the adjustment position before attempting any corrections and do not go crazy trying all the adjustments to solve these problems. Usually, these symptoms are indicative of a bad part. Adjusting all the pots will only create more work later, once the bad part has been replaced. The following is a list of failures associated with the vertical or horizontal circuits:

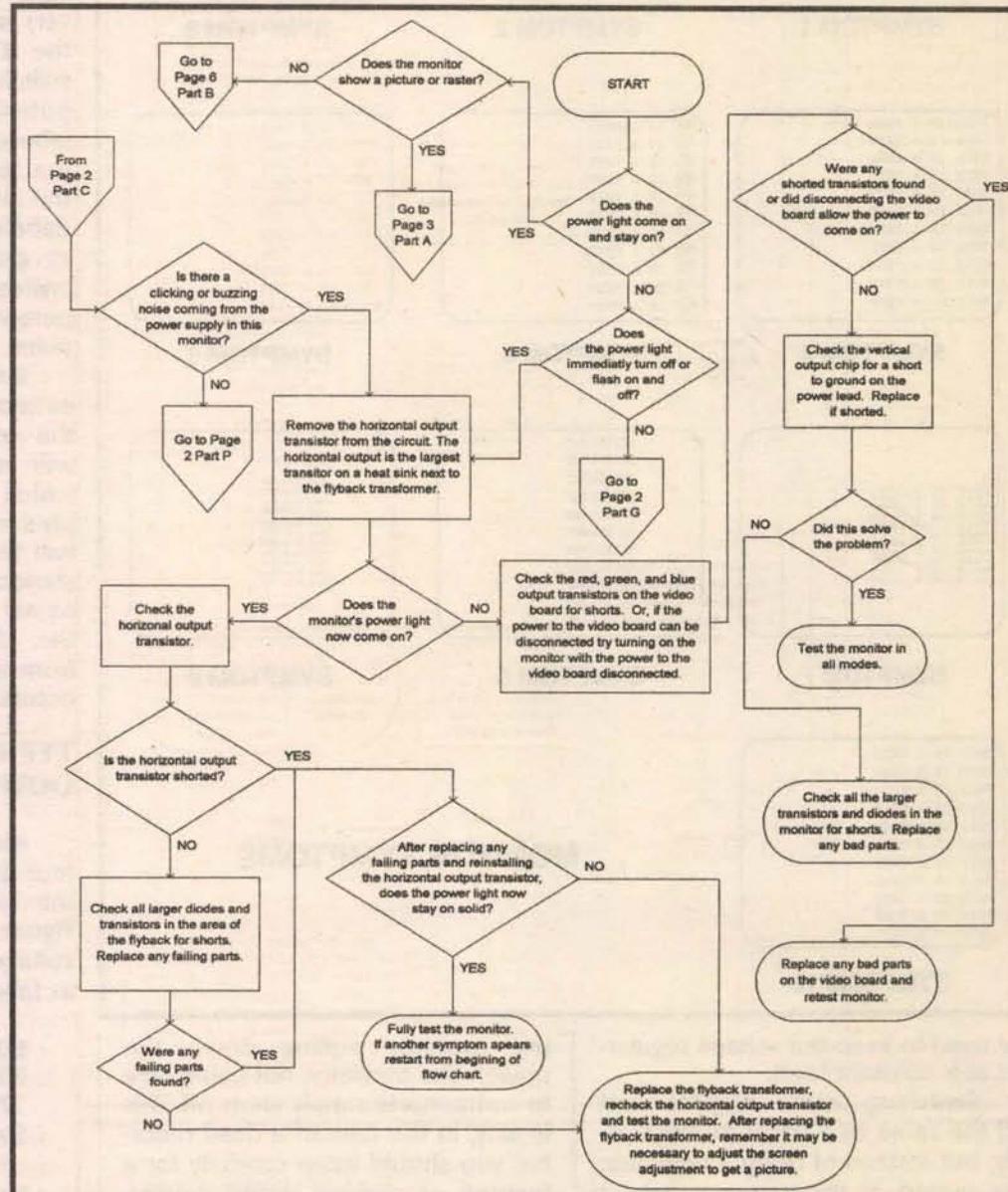
1. Vertical screen shrinkage (see

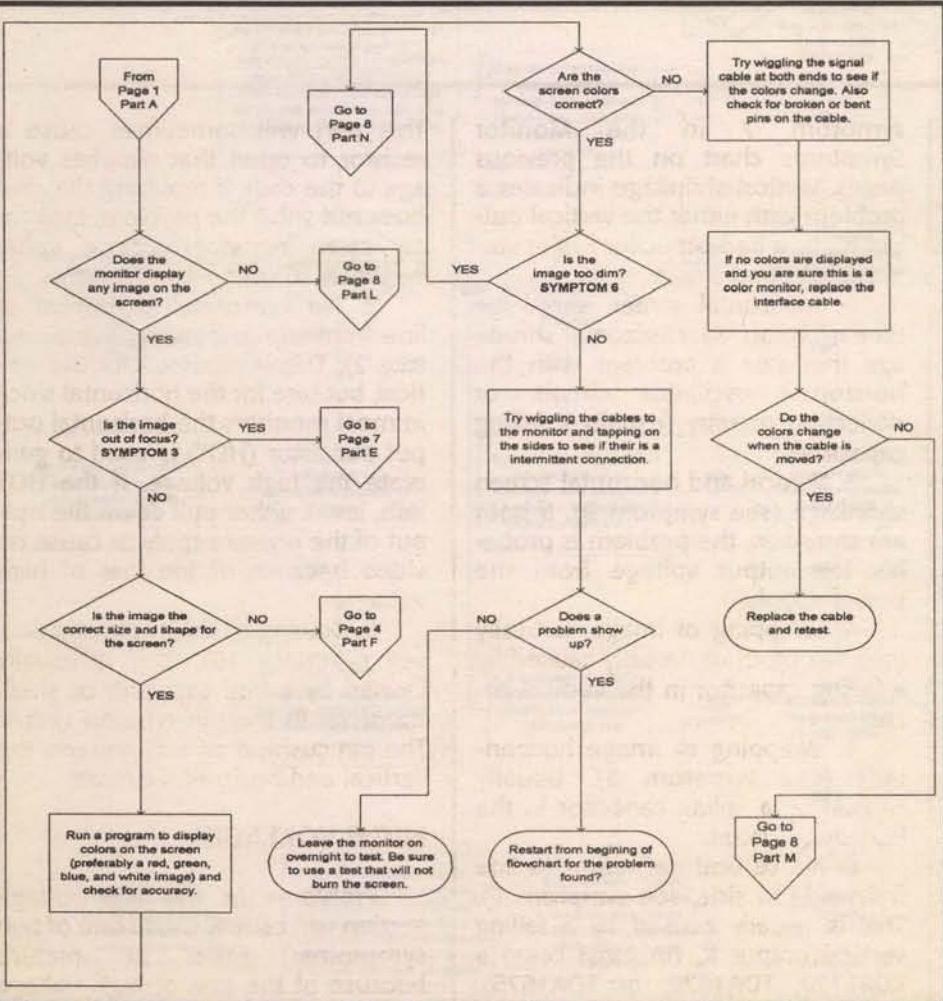
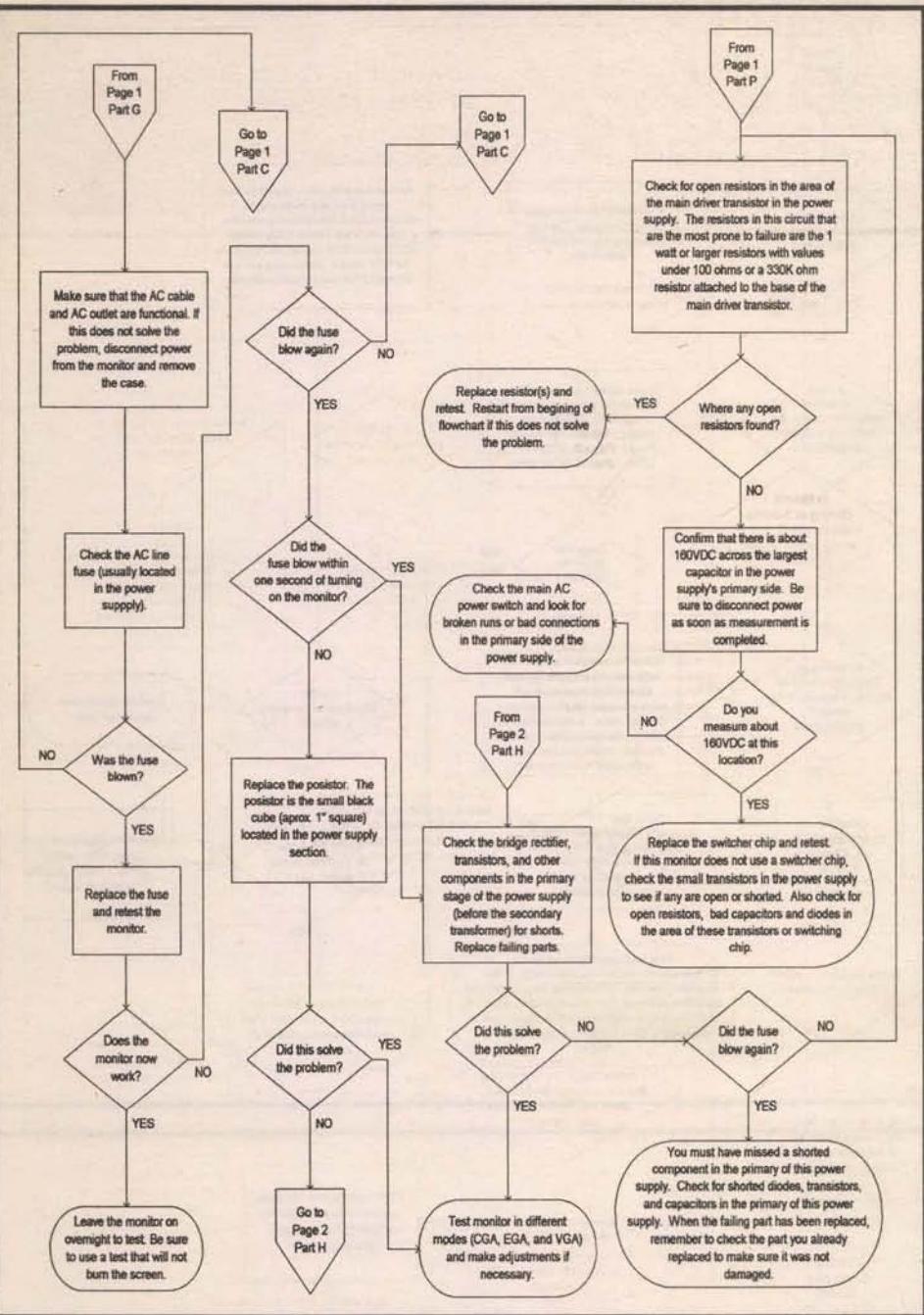
## FLOW CHARTS

The following pages contain a flow chart that will help you fix monitors in a minimum of time.

The complete eight-page flowchart covers the following monitor sections:

Low-Voltage Power Supply  
Interface and Video  
Vertical  
Horizontal  
High Voltage





to the CRT, or a dead monitor, due to a short in the high-voltage circuit, with the previous symptom being more likely to occur. Due to the higher current in the horizontal output stage that feeds into the flyback transformer to generate the high voltage, this section generates more heat than most parts in the monitor and is most prone to failures.

**This information is for use by qualified service personnel only. This is not intended for users or others not familiar with the hazards of the voltages contained inside the monitor.** Much is said about the dangers of the high voltage (for most monitors about 25,000V), but this voltage contains very low current and does not pose a threat unless you wear a pace maker. Most injuries from the high voltage occur after a shock from the high voltage, when reflexes take over causing the technician to pull away from the monitor, scraping themselves on a sharp object inside.

If it becomes necessary to work in the area of the second anode on the CRT (this includes replacing a flyback transformer), be sure to discharge the high voltage before starting work. Even if a CRT has never been connected to a voltage source, it can still carry a charge. Most monitors currently being sold have bleeder resistors in the flyback to dissipate the high voltage when the monitor is turned off. But it is best to play it safe by discharging the CRT before working in the high voltage area of the monitor.

To discharge the second anode (with the power disconnected), use an insulated screw driver or lead with one side connected to chassis ground; use the other end to lift up the rubber suction cup covering the second anode and make contact with the lead underneath.

Remember, if the CRT has been sitting around for more than a few minutes, even if it is not connected to the flyback transformer it is still possible for the CRT to pick up a charge from static in the air. It is recommended that it be discharged again before work commences.

When a monitor is dead (no power), it is easy to test the high-voltage circuit as a possible cause. Remove the horizontal output transistor (this transistor is fairly easy to find as it will usually be the largest transistor in the area of the flyback and on a heatsink) from the circuit and see if the power light will now come on when power is reapplied. If the monitor is still dead, you may have a short elsewhere in the monitor or, most likely, you have a problem in the power supply. Most shorts that are hard enough to pull down the power supply are

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in the high voltage or horizontal output circuit.

If pulling the horizontal output transistor does allow the power supply to come up, then test the transistor (replace if bad). If the horizontal output is not bad or replacing it does not solve the problem, it will be necessary to replace the flyback transformer (after confirming no other shorted transistors or diodes in this area).

For monitors that have power but no picture, a high-voltage probe can be used to test the high-voltage output. **WARNING: DO NOT USE A STANDARD VOLTMETER WITHOUT A HIGH-VOLTAGE PROBE TO TEST THE HIGH VOLTAGE.** If the high voltage is not there or is too low, check the horizontal output transistor. If it is good or replacing it does not solve the problem, it will be necessary to replace the flyback transformer.

All of this is assuming that you have already ruled out the horizontal oscillator and driver stages. Occasionally this problem can also be caused by a bad component in the high-voltage shutdown circuit (designed to protect against over-voltage). Recently, we have seen a high number of NEC monitors with dirty relay contacts causing these same symptoms.

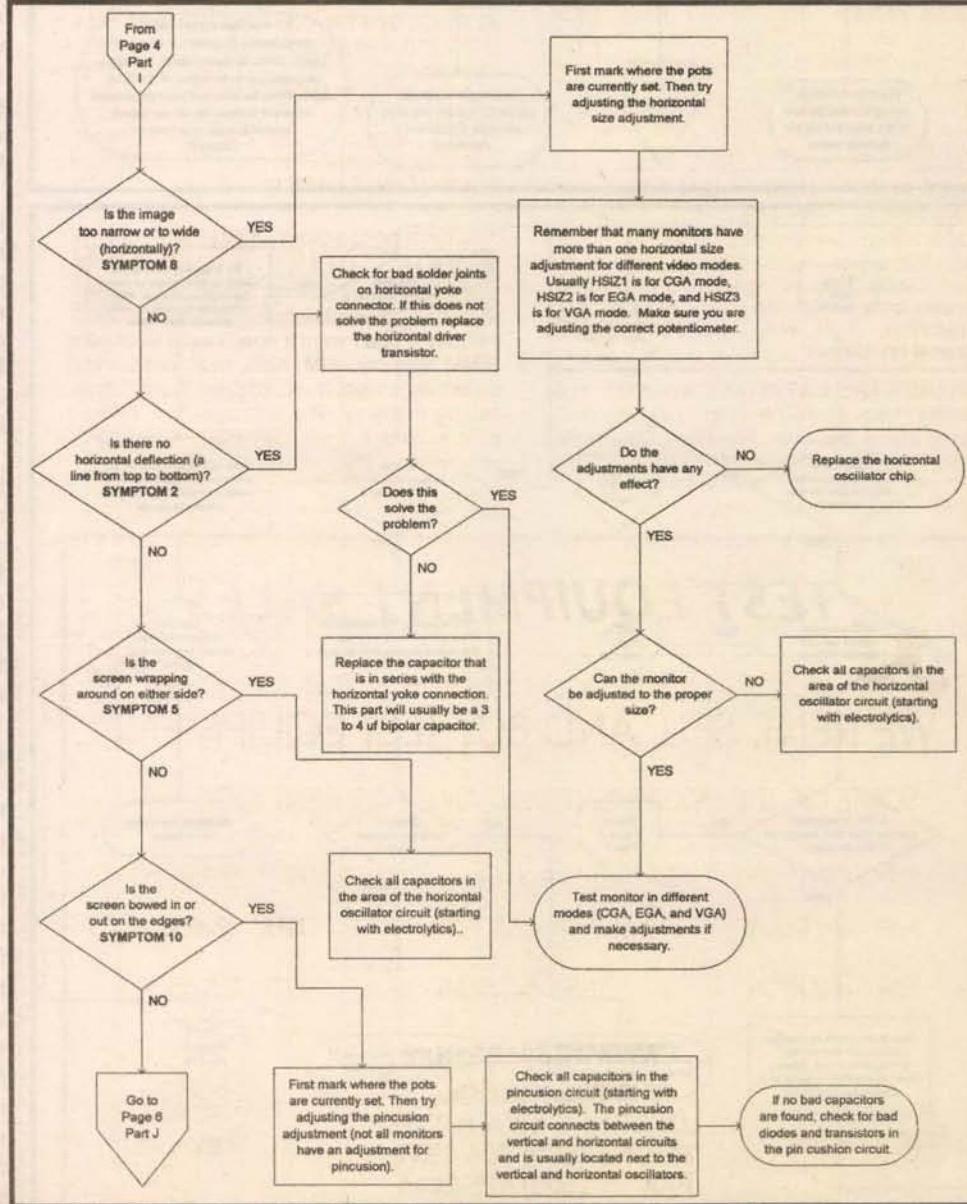
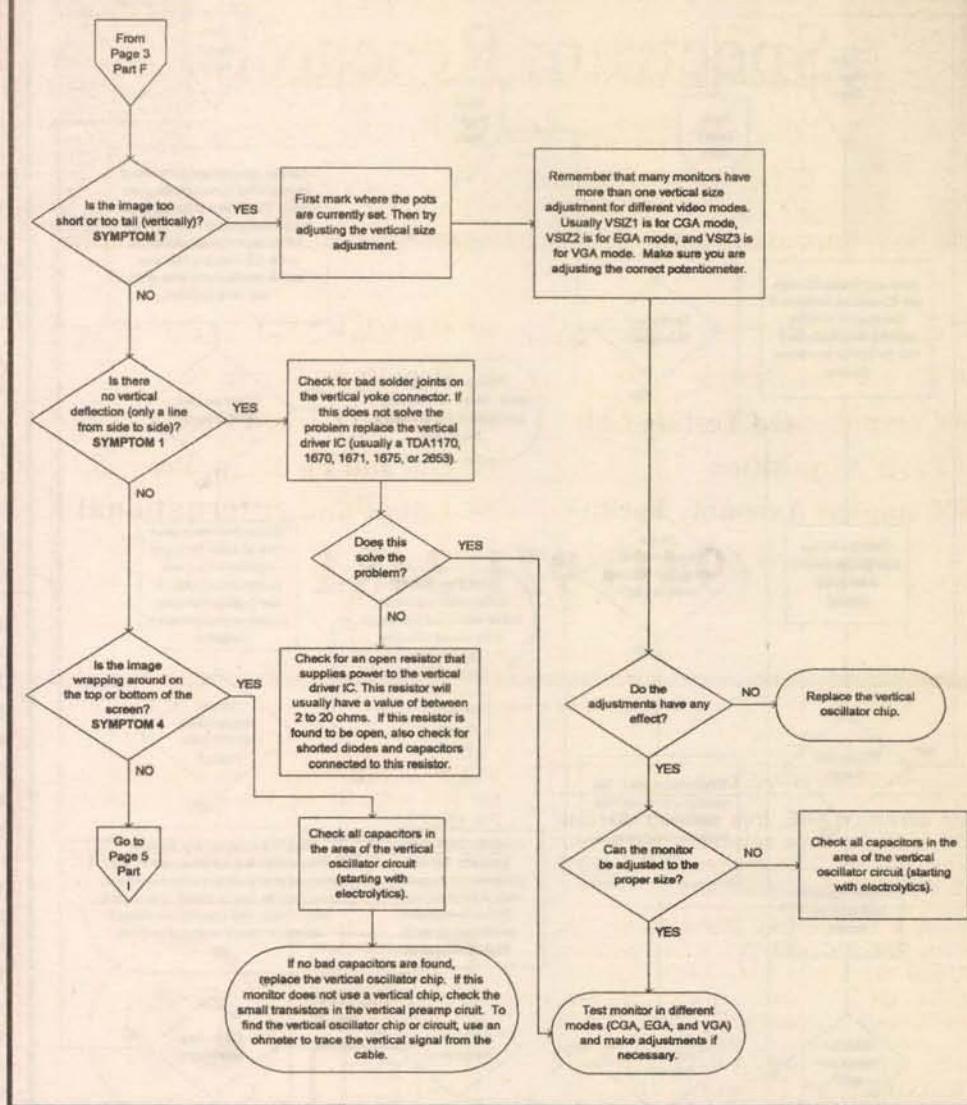
## TESTING COMPONENTS

An ohmmeter is one of the most cost-effective tools available. Many of the newer DVMs have transistor testers built in. But almost all meters have a semiconductor test setting (indicated by the diode schematic symbol) used for testing diodes and transistors.

All semiconductor junctions have a forward (should yield a measurement of .3 to .8 on a DVM) and reverse bias condition (should measure as open on most DVMs), depending on which direction the power is applied. Using an ohmmeter on a good diode, you should measure .3 to .8 in one direction and open in the other direction.

Using two meter leads (positive and negative), and considering a transistor has three leads (emitter, base, and collector), there are six different measurements that can be done. A good transistor should give a forward (.3 to .8) reading on two of those six measurements and open on the other four measurements. The exception on some transistors is that they have a shunting diode that will cause them to measure forward bias on three connections, and reverse on the other three.

When transistors fail, they will either open one or more



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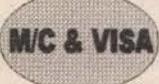
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I think it's a waste to discard disposable cameras. It's very easy to extract your film from a disposable camera, send it off to get developed, and keep all the electronic and mechanical parts for free. By unsnapping plastic catches, the entire camera can be disassembled. This article tells you how. Once inside, the oscillator circuit to charge the flash provides an excellent chance to review or learn a super low-cost oscillator flash circuit.

## INTRODUCTION

The way a disposable camera is suppose to work is that you buy a cheap plastic camera with film already embedded inside. After taking all the pictures, you mail the entire package — film and camera — away to be processed. I thought it would be much better if I could mail away just the film, and keep the rest.

The idea works!

I've had experience only with the Kodak brand, but I imagine others are similar. Nonetheless, the specific instructions I give deal with the Kodak model.

After taking the pictures, the film inside one of the disposable cameras is wound up inside a light-tight 35 mm metal canister, just like the ones you use in your more expensive camera. This metal canister can be removed and sent away for processing.

It seemed goofy to me to send away the rest of the camera to arrive in some land fill somewhere. Aren't these components better used in the hands of creative experimentors? You bet they are!

The last third of the article uses the circuit on the inside to learn about charge oscillators — the basic building block of all switched power supplies.

## STEP-BY-STEP DISASSEMBLY

To get your film out and to take apart the other pieces, you have to first rip off the cardboard outer coating. When you do this, different cracks and crevices will be revealed.

*Don't go poking around inside yet because there is a very real risk of shock unless you know what you're doing.*

Photo 1 shows my camera just after removing the cardboard casing. If you look carefully, you can see a cavity across the front bottom where I've removed the 1.5V AA cell that powered the flash circuitry. My

battery still tested into the good range with one of those polymer heating strip testers that turn color when pressed onto both ends of the battery. Salvage number one.

From here on out in the disassembly, don't touch any metal on or inside the camera. Potentially hazardous voltages could be present. Use a screw-driver-ish tool that is not metal — not conductive. For some of the catches, a toothpick might be the best tool. If you have to use a screwdriver, use one with an insulated handle.

# Recovering Components of Disposable Cameras, and Basics of Flash Tube Circuits

by Brian J. Mork

There is a side panel that covers up the exposed film, which is rolled up in a light-tight 35 mm canister just under the winding knob. To allow the side panel to slide away from the body of the camera, you need to lift up four catches, two on the front and two on the back of the camera.

There was a molded piece of plastic covering the front two catches on my camera. I think the cover piece is there just for cosmetics, or to provide a finger grip while originally using the camera. It has no structural value, so I used a razor blade to slice into it and then bent it off. Release all four catches and slide the cover off.

Photo 2 shows the film cartridge visible just after removing the side panel. Reach inside with a fingernail and pop the film cartridge out. Set it aside for future processing.

The back of the camera is the next panel to remove. It has two catches along the top, which are accessible from the back. Reach inside with your tool and push the catches sideways, away from the winder, toward the view finder window.

There are also two bottom catches that are accessible from the bottom of the camera. Poke into the hole and push straight inward (upward into the camera body) to release these bottom catches.

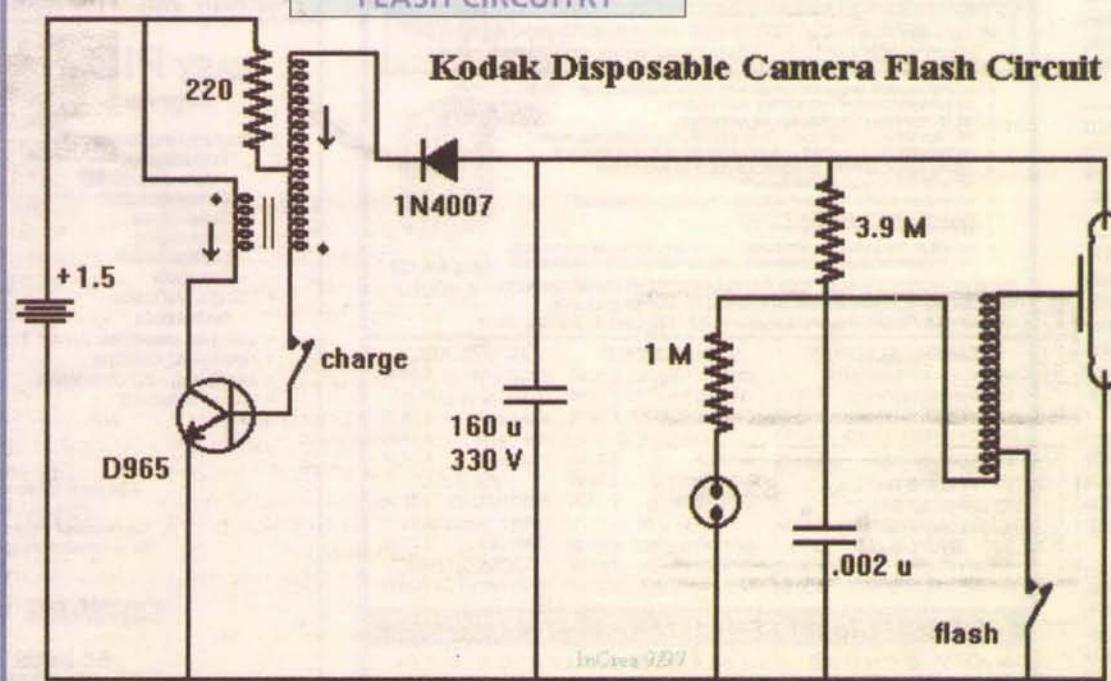
Reach in the hole or recess and gently bend the plastic tab to release, keep-



PHOTO 1

SCHEMATIC FOR THE FLASH CIRCUITRY

Kodak Disposable Camera Flash Circuit



ing a little "pull away" tension on the clear piece. Once a catch is free, block it apart with a toothpick before going onto the other catches.

Next remove the top clear piece: two catches along the top rear edge, three along the top front edge. Save the piece. It has a concave, about  $\sim 1$  cm<sup>2</sup> lens. Remove four mechanical plastic pieces around the metal trigger mechanism for the shutter and the flash.

The metal pieces around the shutter, including the shutter itself, are part of the electrical discharge circuit. Assume they have several hundred

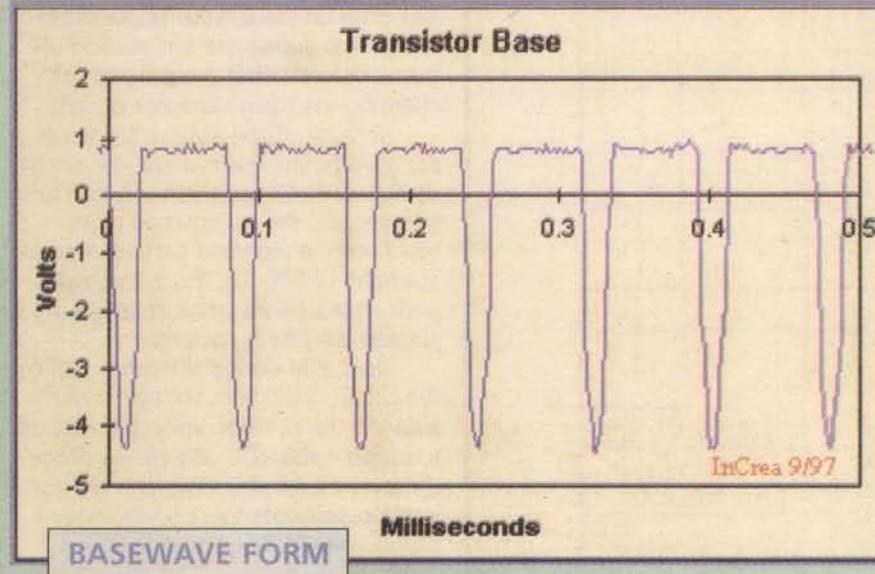
ing the contacts or the resistor leads as you do this).

Initially, a current flow of up to 250 mA may flow, but the RC time constant is about 0.16 seconds. Give it 10 seconds and you should be okay.

Two red wires go from the circuit board to the shutter. The shutter itself is the "FIRE" button on the schematic. When they touch, the flash will trigger. Don't play with this carelessly!! When I held down the charge contact, the metal of the shutter developed 250 VDC across them. The leaf metal charging contact developed a similar voltage.

neered schematic for the flash circuitry. There are three major sections,

each operable independently from the others: a charging oscillator, a blinking



**BASEWAVE FORM**

volts on them unless you've measured otherwise.

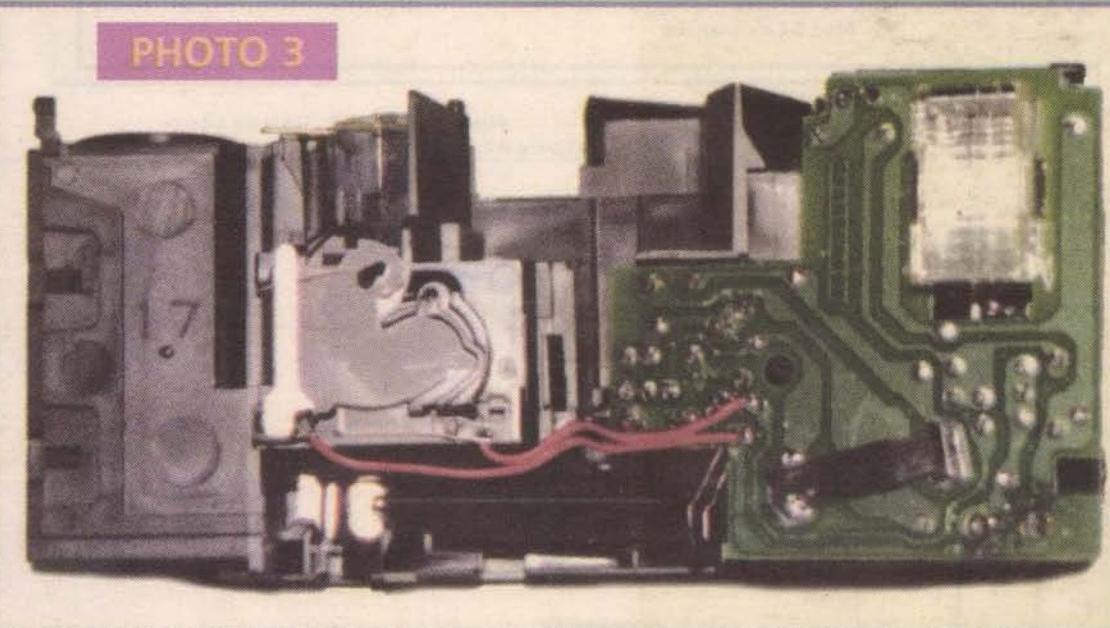
Next remove the front plate. One catch is along the top front, one is along the left side rear, one is on the front face between the trigger mechanism and where the winding knob was. The last one is down inside, almost in the exact center of the front of the camera; you'll have to reach it with a small bladed screwdriver.

The front lens will pop off. Save it. It is a concave,  $\sim 3/8"$  diameter lens with a focal length of about 1.3".

**STOP!** Read the next few paragraphs before touching anything inside the camera.

Photo 3 shows what you'll be looking at. The two larger through-the-board solder connections on the lower side of the visible circuit board are the main charging capacitor connections. The camera I disassembled had a 160  $\mu$ F capacitor, rated to 300 VDC. Shorting the two leads together made a LOUD pop and nearly welded the insulated-handle screwdriver I used to do so.

Check the voltage across these leads with a voltmeter before getting your fingers on the circuit board and before further disassembly. If you'd rather not get a loud pop and arcing, position a 1 Kohm resistor across the two solder connections (without touch-



Several minutes after popping the flash and removing the battery, I still measured more than 100 volts on the contacts, due to residual charge retained on the main capacitor after the flash tube extinguished.

Two catches will let the circuit board come out. Before totally removing the board, mark the metal battery clip with a permanent marker, so you'll know which way to put the battery in. I left my circuit board in the plastic shell for stability.

#### CIRCUIT ANALYSIS

Figure 1 shows a reverse-engi-



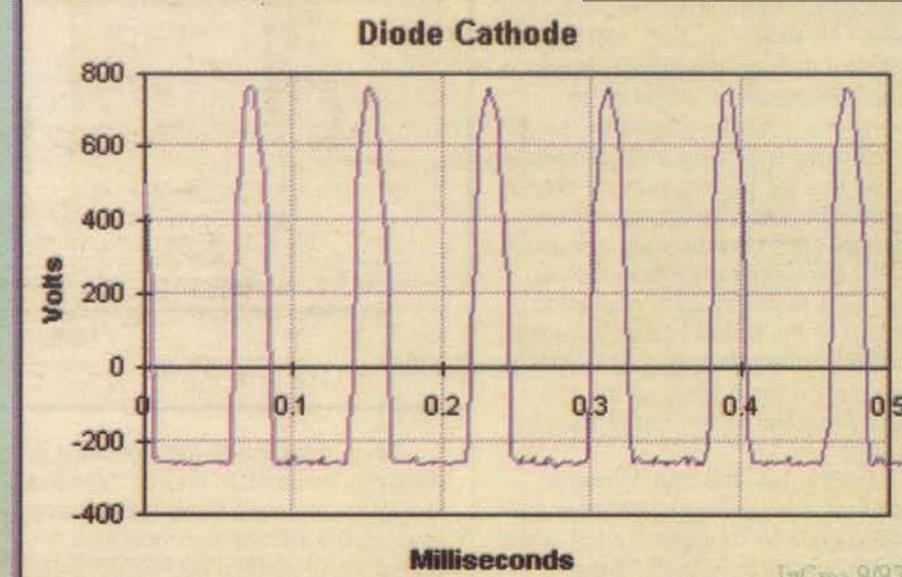
full-charge indicator, and a trigger.

#### The Charging Oscillator

The charging oscillator consists of everything left of the 160  $\mu$ F main charge capacitor. When a battery is in place, but the charge switch is not engaged, the collector sits at about 1.5 VDC, and the base sits at about zero volts.

When the charging switch is closed, current is pulled through the 220-ohm resistor and the last few coils of the transformer secondary. The transistor turns a little bit

#### VOLTAGE AT THE TOP OF THE SECONDARY



negative, significantly below ground.

The voltage on the bottom side of the 220-ohm resistor is driven negative

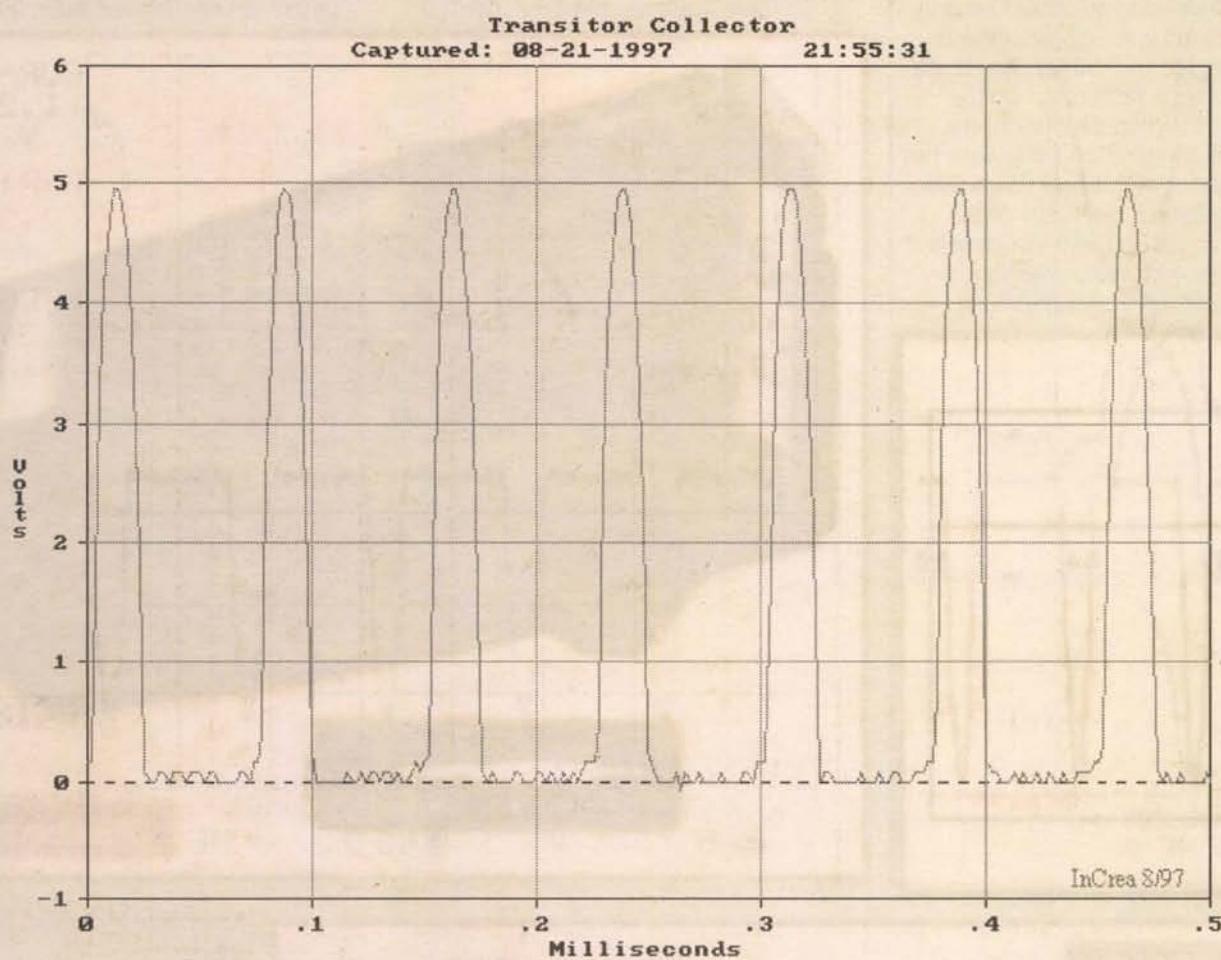
about 2.3 volts below the power supply, implying a maximum current of  $2.3/0.22 \Rightarrow 10.5$  millamps going through the resistor.

The voltage at the top of the secondary drops precipitously toward -300 VDC. The pull of current in the top side of the secondary is conducted by the forward biased diode, and charge is pulled off the top of the capacitor. (Yes, once more, I'll note that really electronics are going through the diode and being deposited on the top of the capacitor.) The + charge depletion on the top of the 160  $\mu$ F main capacitor causes a voltage drop. In the relative phase waveforms, it is during the flat portion of the waveforms that the business of charging the main capacitor occurs.

Because of the positive feedback provided by the transformer, the circuit oscillates. If you use the horizontal axis numbers off the oscilloscope plots, you'll see the repeated pattern occurs at about 12,000 Hz. This is the high-pitch squeal heard when charging most photography flash equipment.

Note that during the other half of the circuit oscillation, voltages reverse polarity: the cathode voltage builds up to about +300 VDC; the base voltage drops to about -4.5 VDC; and the collector overshoots the 1.5 VDC power supply, eventually getting to about 5 volts.

### OSCILLATING THE VOLTAGE



#### VOLTAGE AT THE COLLECTOR

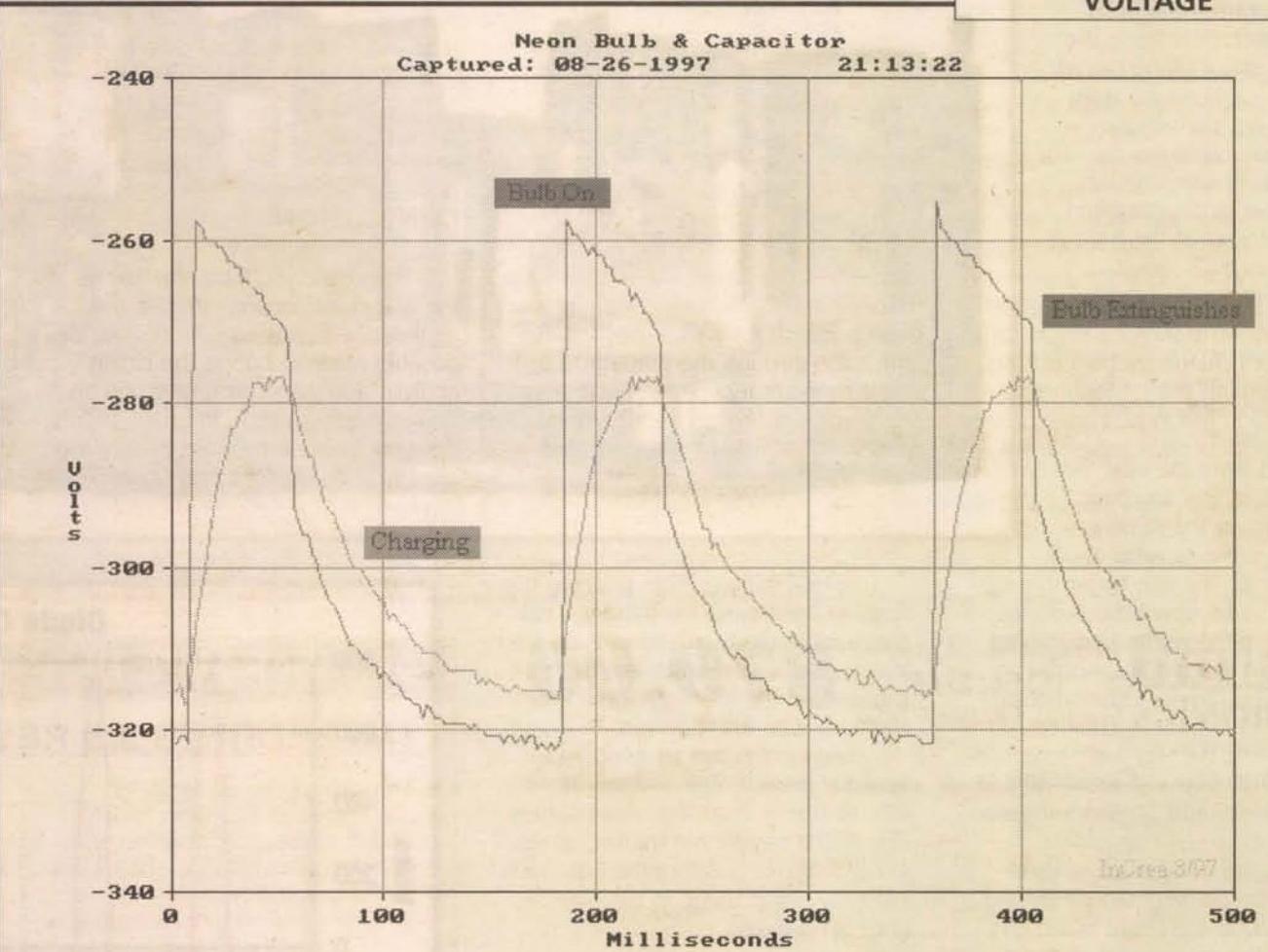
on, pulling the collector toward ground. Current in the primary of the transformer builds up. This is signified by the arrow on the schematic.

This positive feedback induces more current in the secondary, which pumps positive charge toward the bottom of the inductor (as shown on the schematic). VB rises to an even higher voltage. When VB tries to swing up above about 0.7 volts, the transistor turns hard on, as seen on the base waveform. Any attempt to go higher is "shorted" to ground by the base-emitter diode inside the transistor.

When the transistor is full on, the collector is essentially shorted to ground (notice the voltage at the collector hits a minimum of zero volts, but doesn't go below ground), and the current flow through the primary builds up to a maximum. It might help to take a look at all the relative phases of all transistor and transformer terminals.

Notice the polarity dots on the switching transformer are shown on opposite ends because they indicate in-phase voltage rather than the current. As a high voltage is applied to the top of the primary (relative to the bottom of the primary), a high voltage develops on the bottom of the secondary (relative to the top of the secondary).

For the way the transformer is drawn on the schematic, voltages are associated with "opposite" ends, while current is associated with "same" ends.

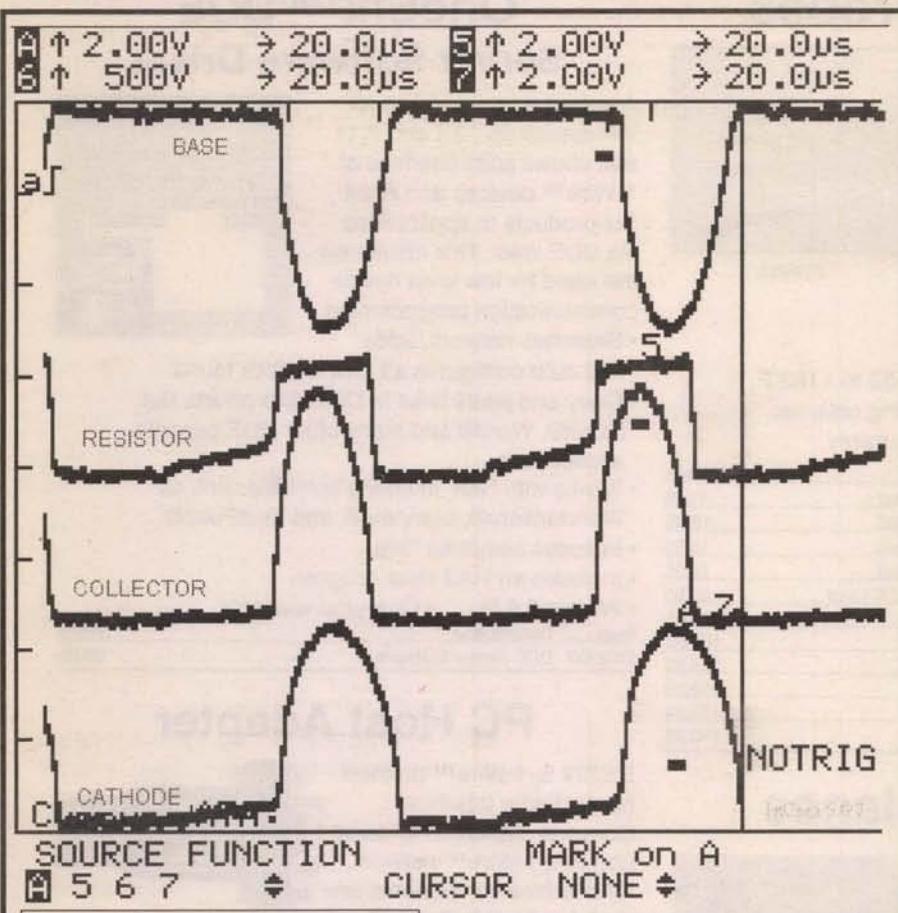


Since the base of the transistor is clamping the bottom end of the transformer secondary a diode drop above ground, the voltage that develops across the secondary pushes the resistor tap and the cathode of the diode

by about a volt, proportional to its tap position on the secondary coil. This is

#### The Blinking Indicator

With voltage building on the main



capacitor, current leaks through the 3.9 Mohm resistor and charges up the 0.002 uF capacitor. As the 0.002 uF capacitor is charged, the voltage magnitude across the 1 Mohm resistor and the neon bulb increases in magnitude.

When it reaches about 300 volts, the bulb arcs across its internal electrodes. The ionized cloud of neon gas has near-zero resistance, so the bulb quickly causes charge to drain off the capacitor through the 1 Mohm resistor. The voltage magnitude drops toward 20% of its peak value (1/4.9 voltage divider).

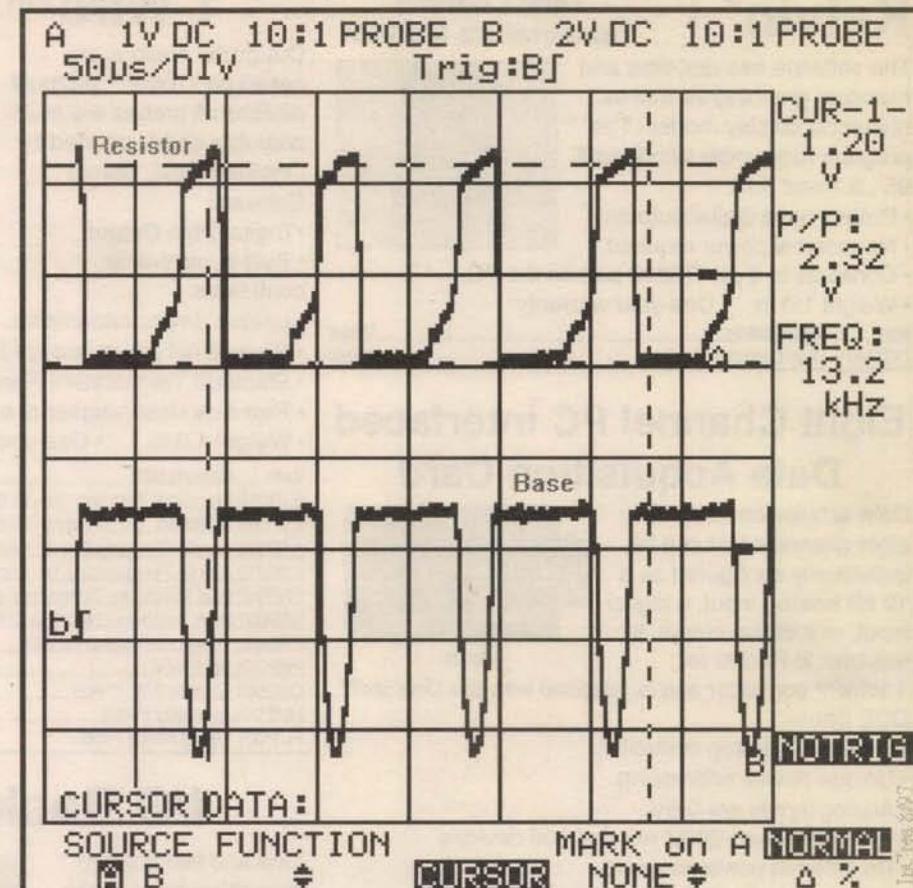
Eventually, it reaches a level where the ionization of the neon gas cannot be maintained. The light goes off.

With the bulb's resistance returned to essentially infinity, charge builds up again on the 0.002 uF capacitor. The cycle repeats over and over again, oscillating the voltage.

#### The Trigger

If you close the "flash" contact, the entire voltage of the main capacitor is shorted to ground through the 3.9 Mohm resistor and the primary of the flash transformer. The flash transformer is a very high ratio voltage step-up transformer that uses the current pulse through the primary to provide a momentary voltage pulse over 1,000 volts. A few of the gas molecules in the strobe bulb are ionized, and immediately attracted to the electrodes, which have just less than 300 volts across them.

As the ions go screaming toward



#### VOLTAGE ON THE BOTTOMSIDE OF THE 220 OHM RESISTOR

an electrode, they collide with other gas molecules, knocking electrons out of them. Very quickly, there is huge number of atoms ramming into each other, releasing Bremsstrahlung radiation — i.e., a flash of white light. When the voltage on the main capacitor is too low in magnitude to sustain the ionized discharge, the flash extinguishes.

#### CONCLUSION

Hopefully, you'll be able to use the above instructions to gain the confidence to not dispose of your disposable camera. I hope the circuit analysis and waveforms give you an understanding you didn't have before. I'm particularly interested in how the photos and diagrams and figures worked for you. Let me know what did and didn't work.

For additional reading on the

topic of disposable camera salvage, check out how others have documented a more formal educational exercise to dissect disposable cameras, from the marketing point of view. I've looked at a few web pages, but I'm not sure of the extent of what's available. Some of it appears to be specifically about the innards, including a lab exercise for students to do marketing studies about the electrical parts. NV

You can contact Brian via E-Mail at mork@usa.net, or write to him c/o InCrea, 4504-C W. Juniper USAFA, CO 80840.

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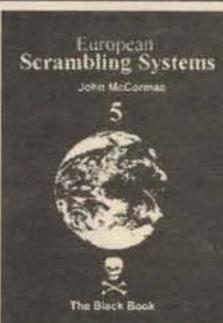
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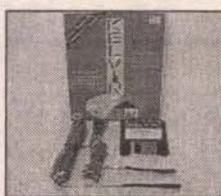
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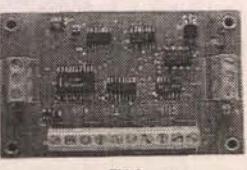
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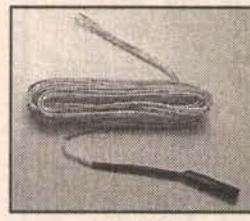


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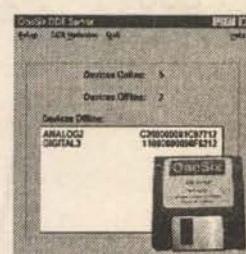
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OneSix DDE Server

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- 2000' Network and 200 1-Wire™ devices.
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Item	Description	Price
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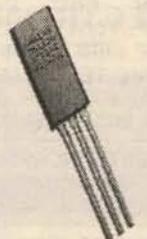
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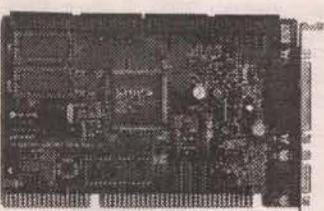
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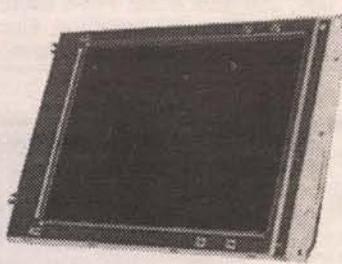
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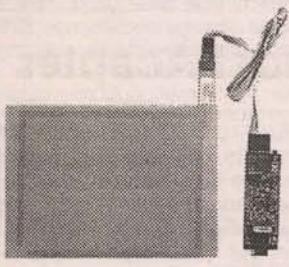
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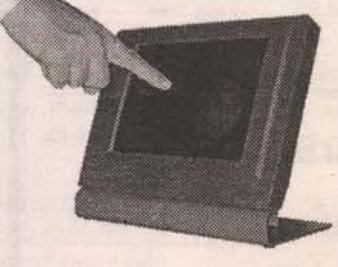
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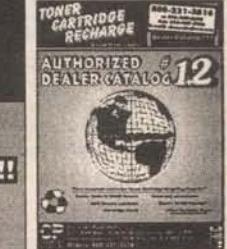
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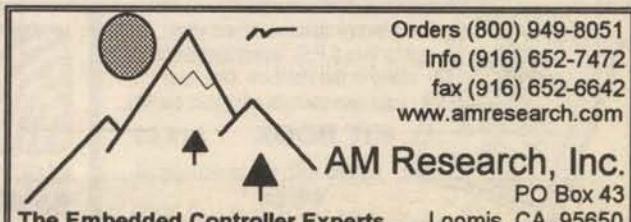
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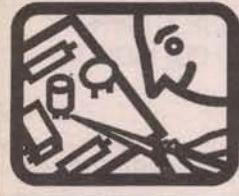
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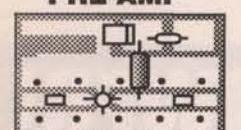
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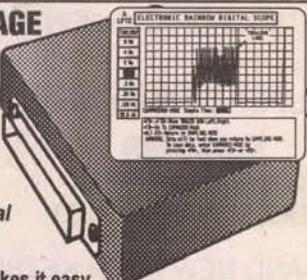
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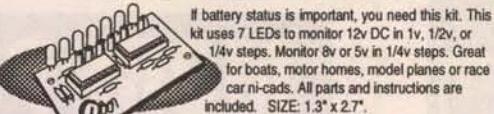


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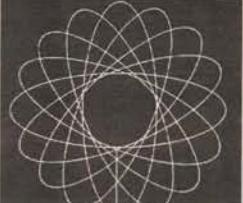
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### E

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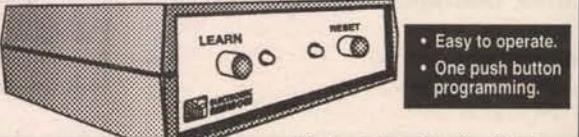


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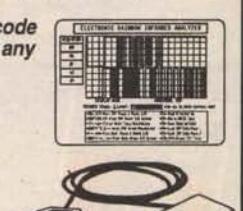
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HP 180A SCOPE (MIL SPEC AN/USM-281A) includes vertical plug-in 1801A (PL1186), horizontal plug-in 1821A (PL1187). Tested: \$195. Manual reproduction: \$15. Davlyn Corp. 1-800-235-6222.

SELL: HP 141T, 8552A, 8553B, SPEC. ANA., \$1,300; HP 141T, 8552B, 8554B, \$1,800. HP 141T, 8552B, 8555A, \$2,000; HP 8690B, \$200; PLUG-INS CALL FOR LOW COST PLUG-INS; HP 5340A, \$1,200; EIP 371 source locking counter, \$1,200; HP 8683B signal generator, \$2,500; HP 432A, 8478A, power meter, \$450; Bird 4430, Thru-line wattmeter and six slugs, \$500; Clarostat 240C decade power resistor, \$200; Cabletron TDR 5000 time domain reflectometer, \$800; HP 11729B carrier noise test set; HP 1725A 265MHz dual ch. scope, \$500; HP 7475A six pen plotter, \$250; HP 7550A, 8 pen graphics plotter, \$400, Matrix 3000 color graphics recorder, \$1,000; HP 5423A structural dynamics analyzer, \$4,000; HP 3575A phase meter, \$800, HP 3437A system voltmeter, \$400; A-Comm Electronics 303-290-8012 Sales@A-comm.com

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# Stamp Applications

Putting  
the Spotlight on  
**BASIC Stamp Projects,**  
**Hints, and Tips**

by Jon Williams

Have you ever stopped to consider how much of our life is governed by clocks? A bunch. We get up at a given time. We go to work at a given time. We finish work at a given time. Our favorite television and radio programs start and stop at a given time. Wow! Just think how out of sync our society would be without clocks.

## It's Time To Get Real Using the Dallas Semiconductor DS1302 RTC

A software real-time clock is not a practical exercise when it comes to the BASIC Stamp. Even if one succeeded in implementing the clock function, without interrupts, it's not likely that the Stamp could handle any additional control. It would be too difficult to keep the software clock in sync. It's on occasions like these — when software really isn't the answer — that we turn to external hardware. Thankfully, there are choices. And PBASIC makes them easy to use.

Before we get to hardware specifics, let's talk about time and how to deal with it in a microcontroller. When we refer to time, we're concerned with the hours, minutes, and the appropriate side of noon (AM or PM). This can be a headache to deal with in software. For example, if the time was 11:45 AM and we wanted to add 20 minutes, we'd have to add the 20 to the 45, notice that we went past 60, carry to the hours variable, check that we went from AM to PM, blah, blah, blah. What a hassle! There is an easier way.

### Just a minute, please ....

I once worked for a large irrigation company, and was involved with many teams that designed and built sprinkler timers. Sprinkler timers deal with time on two levels: 1) when to start the sprinklers, and 2) how long the sprinklers should run. It's interesting to note that no matter what the scope of the irrigation controller — from those you can buy at garden centers for residential use, to the big, computerized irrigation systems used on golf courses — time was always dealt with as a single variable. Conversion routines are used to interface with people.

Life for the Stamp would be quite a lot easier if it only had to deal with one variable for the time instead of three. We move from three variables to one by converting the hours, minutes, and AM/PM

to minutes. Now you let the Stamp deal with time as a value between zero (12:00 AM) and 1439 (11:59 PM). It's a reasonably simple matter to convert between this raw time format and something we humans can live with.

This month, we're going to demonstrate how to deal with real-time by building something that most of us use every day: an alarm clock. We'll use an external RTC chip and take advantage of the LCD interface we covered last month. This project should give you a firm grounding in time-based control, and teach you a math trick or two along the way.

### The Dallas Semiconductor DS1302

For our alarm clock, we'll be using the DS1302 from Dallas Semiconductor. This eight-pin DIP keeps track of seconds, minutes, hours (with an AM/PM indicator, if running in 12-hour mode), date of month, month, day of week, and year with leap year compensation valid up to 2100. As a bonus, the DS1302 contains 31 bytes of RAM that we can use as we please. And for projects that use main's power, the DS1302 also contains a trickle-charging circuit that can charge a back-up battery.

Connecting to the Stamp is very straightforward. The DS1302 uses the same three-wire interface as the DS1620 thermometer (Apr. '95) and the DS1267 digital pot (Aug. '96). This allows us to take advantage of the BS2's SHIFTOUT and SHIFTIN commands. To write a value to the DS1302, we'll send (SHIFTOUT) the register address first, then the data for that register. The LSB of the address determines whether the operation is a write (0) or a read (1). To read from the DS1302, we send the address, then immediately read back (SHIFTIN) the register value.

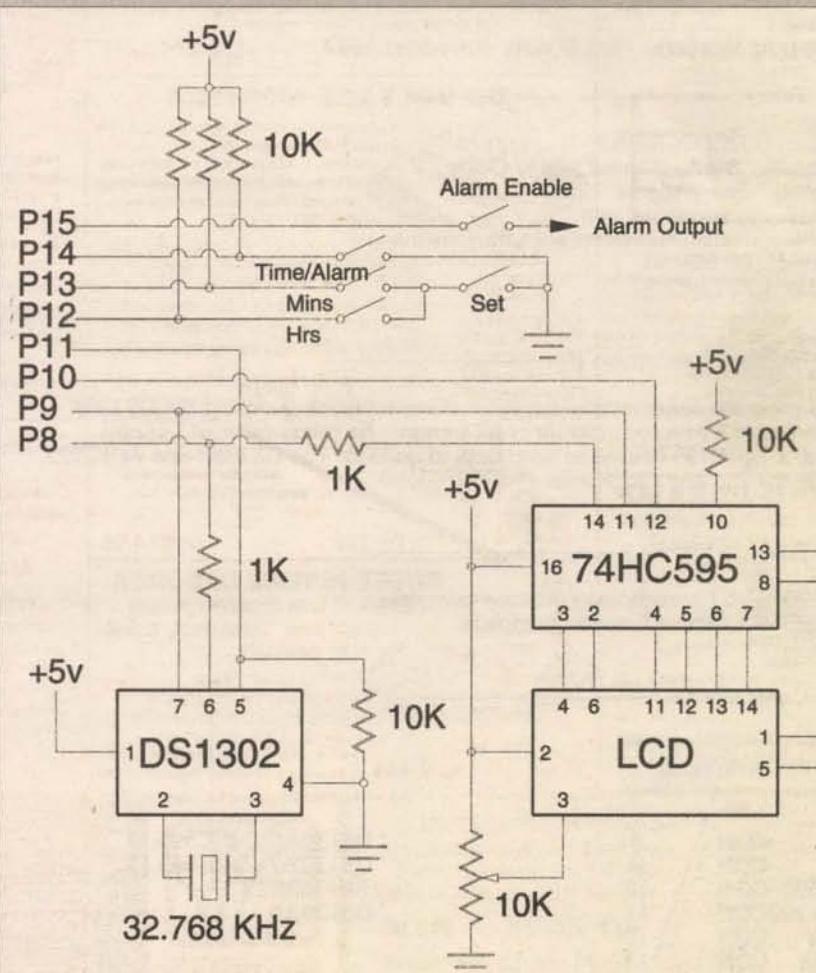
For our project, we'll share the clock and data lines with a 74HC595 shift register. This cuts down the number of Stamp pins required to implement the alarm clock. For details on using the 74HC595 with an LCD, please refer to the Oct. '97 issue (More LCDs ...).

### Time format conversion

In order to keep our interface with the DS1302 simple, we'll use it in the 24-hour mode. In this mode, we don't have to fuss with the AM/PM indicator. (If you want to know how, download DS1302.BS2 from my FTP directory.) For a 12-hour display, we'll deduce AM/PM mathematically.

Another compelling reason to use our raw time format is that the DS1302 stores its registers in BCD (binary coded decimal). In case you haven't dealt with BCD before, here it is in a nutshell: BCD is a method of storing a value between zero and 99 in a byte-sized variable. The ones digit occupies the lower nibble, the tens digit the upper. Neither nibble of a BCD byte is allowed to have a value greater than nine. Thankfully, the BS2 allows nibble-sized variables and, more importantly, it allows variables to be overlaid. We discussed this technique back in the Aug. '97 issue (PBASIC Programming With Style) and now we're going to use it.

If you study the variables section of Listing 1, you'll see that we've defined each time element as a byte, then overlaid the tens and ones nibbles. These overlaid nibble definitions do not occupy



# Stamp Applications:

any more memory in the Stamp. With these definitions, converting the time from the DS1302 to our raw format takes just one line of code:

```
rawTime = (hr10 * 600) + (hr01 * 60) + (mn10  
* 10) + mn01
```

Get a pencil and paper, and do it longhand. What you'll find is that the result is always a value between zero and 1439. Keep in mind that we're using 24-hour mode, so the hours value is always between zero and 23.

Converting back is just a bit trickier but, once you get the hang of it, you'll find the technique very useful. The key to this conversion routine is the modulus operator (//). The modulus operator returns the remainder of a division. For example, 5 // 2 (read "five mod two") returns one.

Here's the code to convert from our raw (minutes) format to the BCD values required by the DS1302:

```
hr10 = rawTime / 600  
hr01 = rawTime // 600 / 60  
mn10 = rawTime // 60 / 10  
mn01 = rawTime // 10
```

This first line is easy. Since there are 600 minutes in 10 hours, we simply divide by 600 to get the tens value. Remember that the Stamp uses integer mathematics — the result of a division will always be a whole number. Getting the ones digit of the hours means dividing by 60 since there are 60 minutes in one hour. But first, we've got to get rid of the tens. This is where the modulus operator helps us. Since the Stamp does math from left to right, we first mod the raw value by 600. This step gets rid of the tens of hours. Now we can divide by 60 to get the ones.

Getting the minutes works in the same fashion. First, we mod the raw time by 60 to get rid of all the hours, then we divide by 10 to get the tens digit.

The final step is getting to the ones minutes, so we mod the raw time by 10. You'll notice that this technique does not modify the value of the rawTime variable.

Since the nibble variables are overlaid with the time register variables, our BCD bytes are ready to SHIFTOUT to the DS1302. Pretty nifty, isn't it? Unless you've used this technique before, you may not be entirely comfortable with the modulus operator. That's okay, everything gets easier with time (no pun intended). Again, I suggest that you work through the steps with a pencil and paper so that you have a firm grasp of the technique.

## Setting the clock

The modulus operator exhibits a behavior that can be very useful: keeping a variable within a range. The result of  $x \text{ // } y$  will always fall between zero and  $y-1$ . And, unlike the MIN and MAX operators, the modulus operator causes the result to wrap around. This table will give you a quick idea of how it works:

0 // 3 = 0	
1 // 3 = 1	
2 // 3 = 2	
3 // 3 = 0	
4 // 3 = 1	B Notice the wrap around

We'll take advantage of this behavior in our time setting routine. Based on the user input, we'll either add one or 60 (an hour) to our raw time and then mod by 1440. This will keep the time between 0 and 1439 and handle the rollover for us. Without the modulus operator, we'd be forced to use a convoluted IF-THEN construct and test for values. No, thank you.

There is one last modulus trick I'd like to share with you before we move on to our clock circuit and software. In the description above, and in the

## Sources

For more information on the BASIC Stamp, contact:

### Parallax, Inc.

3805 Atherton Road, #102, Rocklin, CA 95765  
phone (916) 624-8333  
Internet <http://www.parallaxinc.com>

### Scott Edwards Electronics

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phone 520-459-4802; fax 520-459-0623  
Internet archive (catalog, user manuals, samples)  
located at <ftp://nutsvolts.com> in directory  
[/pub/nutsvolts/scott](http://nutsvolts.com/scott)  
E-Mail: [72037.2612@compuserve.com](mailto:72037.2612@compuserve.com)

### Jon Williams

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Internet: <http://members.aol.com/jonwms>  
<http://members.aol.com/jonwms/stamps>

### Dallas Semiconductor

1-800-336-6933 (for orders less than 20  
pieces)<http://www.dalsemi.com>

clock we present here, we're simply adding time and rolling over. But what if we wanted to add another input to this project that told the Stamp to subtract time? How would we handle that?

Hang on, this gets a bit gory .... What you'll do to subtract from the raw time is to add the modulus value (1440) minus the amount you want to subtract. So, to subtract a minute, you'll actually add 1439 to the raw time and then apply the modulus of 1440. For example, to subtract an hour

' Listing 1  
' Stamp Applications: Nuts & Volts, November 1997

' [ Title ]

' File..... BS2CLOCK.BS2  
' Purpose... Stamp II-based Alarm Clock  
' Author.... Jon Williams  
' E-mail.... [jonwms@aol.com](mailto:jonwms@aol.com)  
' WWW..... <http://members.aol.com/jonwms>  
' Started... 20 SEP 97  
' Updated... 27 SEP 97

' [ Program Description ]

' This program demonstrates basic timekeeping functions using the DS1302  
' from Dallas Semiconductor. In order to minimize the number of I/O pins  
' used, a 74HC595 is used to send data to an LCD. The DS1302 and 74HC595  
' share the Dio and Clock lines.

' [ Revision History ]

' 26 SEP 97 : Timekeeping functions complete  
' 27 SEP 97 : Alarm function complete

' [ Constants ]

I/O Pin Definitions

Dio	CON	8
Clk	CON	9
CS_595	CON	10
CS_1302CON	CON	11
SetHr	CON	12
SetMn	CON	13
TmAlrm	VAR	In14
Alarm	VAR	Out15

DS1302.6, 74HC595.14  
DS1302.7, 74HC595.11  
74HC595.12  
DS1302.5

### DS1302 Registers

WrSc	CON	\$80
RdSc	CON	\$81
WrMn	CON	\$82
RdMn	CON	\$83
WrHr	CON	\$84
RdHr	CON	\$85

' write seconds  
' read seconds

CWPr	CON	\$8E
WPr1	CON	\$80
WPr0	CON	\$00

' write protect register  
' set write protect  
' clear write protect

WrBrst	CON	\$BE
RdBrst	CON	\$BF

' write burst of data  
' read burst of data

WrRam	CON	\$C0
RdRam	CON	\$C1

' RAM address control

T24hr	CON	0
T12hr	CON	1
AM	CON	0
PM	CON	1

' 24 hour clock mode  
' 12 hour clock mode

AlrmLen	CON	1
---------	-----	---

' length of alarm (in minutes)

### LCD control characters

ClrLCD	CON	\$01
CrsrHm	CON	\$02
CrsrLf	CON	\$10
CrsrRt	CON	\$14
DispLf	CON	\$18
DispRt	CON	\$1C
DDRam	CON	\$80

' clear the LCD  
' move cursor to home position  
' move cursor left  
' move cursor right  
' shift displayed chars left  
' shift displayed chars right  
' Display Data RAM control

# Stamp Applications:

from the raw time, you'll add 1380, then apply the modulus of 1440. This technique takes advantage of the wrap-around behavior of the modulus operator. To perform a subtraction, we simply wrap around something less than a full "turn." Let's go through one to see how this works:

- 8:00 PM (20:00) has a raw time value of 1200
- Subtract one minute:
  - $1200 + (1440 - 1) = 2639$
  - $2639 // 1440 = 1199$
  - $\{1200 - 1 = 1199\}$
- Subtract an hour:
  - $1200 + (1440 - 60) = 2580$
  - $2580 // 1440 = 1140$
  - $\{1200 - 60 = 1140\}$

At first, this may look like a lot of work. Please trust me when I tell you that it isn't. These modulus operator tricks will streamline your programs, saving valuable EEPROM space for other code. And it's always a good idea to write efficient code, even when the program is "small." Save yourself a possible rewrite — you never know when a small program will grow into a monster.

## Our alarm clock

Now that we've introduced the DS1302 and thoroughly covered the modulus operator, the rest of our alarm clock project is a breeze. My design

goal was to use no more than eight of the BS2's I/O pins for the time-keeping and display elements. Four of these pins are used to communicate with the DS1302 and the 74HC595. The rest are used for time-setting buttons and the alarm enable.

To set the clock, press and hold the SET button, then press either the MINUTES or HOURS button to change the time. The BUTTON command debounces the inputs and, with the auto-repeat feature, allows us to change the time quickly by holding either of the time-set buttons. The state of the Time/Alarm input determines which value is displayed and changed. The software is simplified by using an array to hold the raw time values and using the Time/Alarm input as a pointer into the array. When we send the new time to the clock, the seconds value is always reset to zero.

You'll notice that I cheated a bit with the alarm. From a software standpoint, the alarm is always active. This keeps the program simple. The alarm is disabled by opening a switch connected to the alarm pin. We check for an alarm by comparing the current time with the alarm time. This comparison is done inside a loop so that we can activate the alarm pin for any number of minutes we choose (AlrmOut constant) without worrying about crossing midnight. For alarm outputs

shorter than one minute, you can modify the code and use the seconds value returned from the DS1302.

Okay, it's up to you now. Download the DS1302 documentation from Dallas Semiconductor, get out your breadboards, and build the clock. Once you've got it working, you might want to challenge yourself with adding features. How about a second alarm? How about adding everyone's favorite: a snooze button? And why not add another switch to determine the direction (add or subtract) of the hours and minutes time-set buttons? Next month, we'll talk about some possible solutions to these problems.

## Time for the BS1?

I can imagine that some BS1 users are feeling just a bit slighted, and I certainly understand. While it is possible to connect the DS1302 to the Stamp 1, the process uses up a lot of code space and doesn't make room for many features. But don't give up, there is another solution. Tune in next month and I'll show you how to build a BS1-based alarm clock with a couple of serial modules. Until then, feel free to download DS1302.BAS from my FTP directory if you'd like to experiment with the DS1302. NV

CGRam	CON	\$40	' Char Gen RAM control	GOSUB LCDcmd PAUSE 5
' —[ Variables ]————			' put in 4-bit mode	
addr	VAR	Byte	' DS1302 address to read/write	GOSUB LCDcmd char = %0010
ioByte	VAR	Byte		GOSUB LCDcmd char = %00001100
secs	VAR	Byte		GOSUB LCDcmd char = %00000110
sc10	VAR	secs.HIGHNIB		GOSUB LCDcmd char = ClrLCD
sc01	VAR	secs.LOWNIB		GOSUB LCDcmd
mins	VAR	Byte		
mn10	VAR	mins.HIGHNIB		
mn01	VAR	mins.LOWNIB		
hrs	VAR	Byte		
hr10	VAR	hrs.HIGHNIB		
hr01	VAR	hrs.LOWNIB		
ampm	VAR	hrs.Bit5	' 0 = AM, 1 = PM	
tMode	VAR	hrs.Bit7	' 0 = 24, 1 = 12	
rawTime	VAR	Word(2)		
work	VAR	Word	' raw storage of time values	
oldSc	VAR	Byte	' work variable for display output	
apChar	VAR	Byte	' previous seconds value	
			' "A" (65) or "P" (80)	
char	VAR	Byte		
temp	VAR	Byte	' character to send to LCD	
lcd_E	VAR	temp.Bit2	' work variable for LCD routine	
lcd_RS	VAR	temp.Bit3	' LCD Enable pin	
			' Register Select (1 = char)	
butn	VAR	Byte		
alarmX	VAR	Bit	' BUTTON workspace variable	
' —[ EEPROM Data ]————			' disp on, crsr off, blink off	
' —[ Initialization ]————			' inc crsr, no disp shift	
Init:	DirH = %10001110			
addr	= CWPr			
ioByte	= WPr0			
GOSUB RTCout				
oldSc	\$99			
tMode	= T24Hr			
rawTime(0)	= 360			
GOSUB SetRTm				
' Initialize the LCD (Hitachi HD44780 controller)				
LCDini:	PAUSE 500			
char	= %0011			
' let the LCD settle				
' 8-bit mode				
' —[ Subroutines ]————				
' send a byte (ioByte) to the DS1302 location specified by addr				
RTCout:	HIGH CS_1302 SHIFTOUT Dio,Clk,LSBFIRST,[addr,ioByte]			

## Stamp Applications:

```

LOW CS_1302
RETURN

' get a byte (ioByte) from the DS1302 location specified by addr

RTCl: HIGH CS_1302
SHIFTOUT Dio,Clk,LSBFIRST,[addr]
SHIFTIN Dio,Clk,LSBPRE,[ioByte]
LOW CS_1302
RETURN

' convert raw time format to BCD bytes for DS1302

SetRTm: hr10 = rawTime(1) / 600
hr01 = rawTime(1) // 600 / 60
mn10 = rawTime(1) // 60 / 10
mn01 = rawTime(1) // 10
secs = $00

' use burst mode to set the clock and calendar
' - do not remove the third SHIFTOUT line
' - you must send 8 bytes for data to be written in burst mode

SetTm: HIGH CS_1302
addr = WrBrst
temp = 0
SHIFTOUT Dio,Clk,LSBFIRST,[addr]
SHIFTOUT Dio,Clk,LSBFIRST,[secs,mins,hrs]
SHIFTOUT Dio,Clk,LSBFIRST,[temp,temp,temp,temp,temp]
LOW CS_1302
RETURN

' use burst mode to grab time (hrs, mins & secs)

GetTm: HIGH CS_1302
addr = RdBrst
SHIFTOUT Dio,Clk,LSBFIRST,[addr]
SHIFTIN Dio,Clk,LSBPRE,[secs,mins,hrs]
LOW CS_1302
rawTime(1) = ((hr10 & %11)*600)+(hr01*60)+(mn10*10)+mn01
RETURN

Send command to the LCD

LCDcmd: lcd_RS = 0           ' command mode
GOTO LCDout

' Write ASCII char to LCD

LCDwr: lcd_RS = 1           ' character mode

LCDout: temp.HIGHNIB = char.HIGHNIB   ' get high nibble
lcd_E = 1
SHIFTOUT Dio, Clk, MSBFIRST, [temp]
PULSOUT CS_595, 1
lcd_E = 0                     ' drop Enable line low
SHIFTOUT Dio, Clk, MSBFIRST, [temp]
PULSOUT CS_595, 1

temp.HIGHNIB = char.LOWNIB    ' get low nibble
lcd_E = 1
SHIFTOUT Dio, Clk, MSBFIRST, [temp]
PULSOUT CS_595, 1
lcd_E = 0
SHIFTOUT Dio, Clk, MSBFIRST, [temp]
PULSOUT CS_595, 1
RETURN

' Show time in LCD
' - the time displayed is controlled by the position
' - of the TmAlrm switch input

ShowTm:      char = DDRam+$02
GOSUB LCDcmd
                                ' move to third position in LCD

work = rawTime(TmAlrm)
hrs = work / 60
mins = work // 60
IF TmAlrm = 1 THEN ST0
secs = 0
                                ' get the raw time
                                ' extract (decimal) hours
                                ' extract (decimal) minutes
                                ' show zero seconds if alarm

ST0: apChar = "A"
IF hrs > 0 THEN ST1
hrs = 12
GOTO ST3
                                ' zero hours -> 12 AM

ST1: IF hrs > 11 THEN ST2
GOTO ST3

ST2: apChar = "P"
IF hrs = 12 THEN ST3
hrs = hrs-12
                                ' 13 - 23 -> 1 - 11 PM

ST3: char = hrs DIG 1+48
IF char <> "0" THEN ST4
char = " "
                                ' get hours, convert to ASCII
                                ' remove leading zero

ST4: GOSUB LCDwr
char = hrs DIG 0+48
GOSUB LCDwr
char = "."
GOSUB LCDwr
char = mins DIG 1+48
GOSUB LCDwr
char = mins DIG 0+48
GOSUB LCDwr
char = ":" 
GOSUB LCDwr
char = sc10+48
GOSUB LCDwr
char = sc01+48
GOSUB LCDwr
char = " "
GOSUB LCDwr
char = apChar
GOSUB LCDwr
char = "M"
GOSUB LCDwr
oldSc = secs
                                ' write hours.tens
                                ' write hours.ones
                                ' reset check value

EndST: RETURN

```

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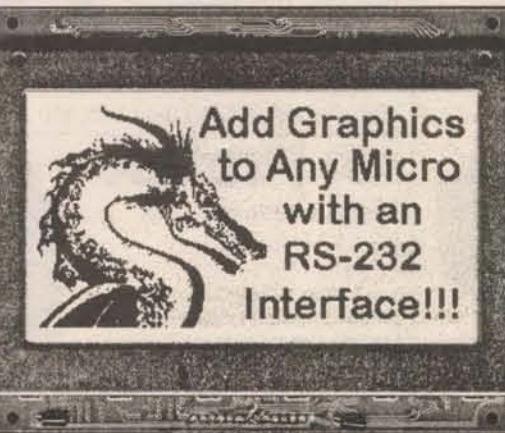
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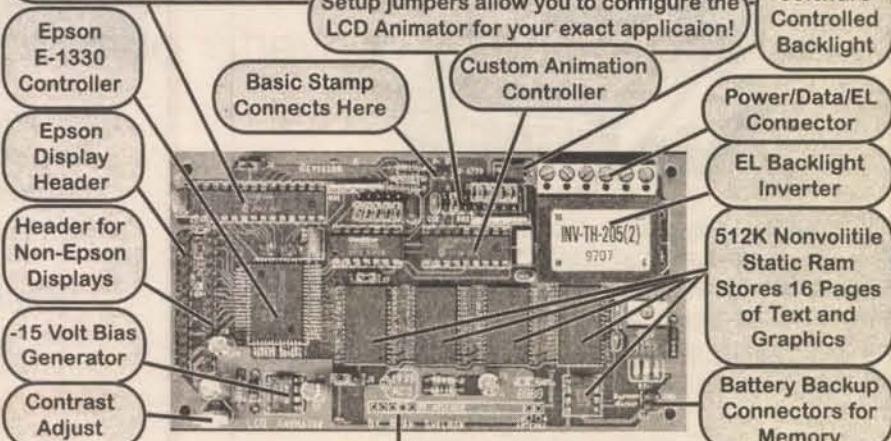
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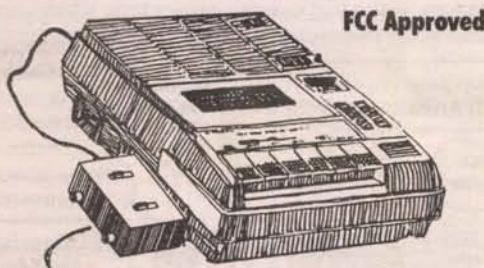
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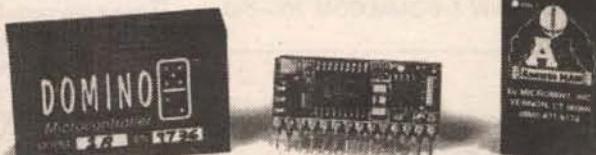
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**PORTABLE SCOPES:** **Tek 222A** (10MHz) digital storage/readout, handheld battery-operated \$1,250 (many accessories available). **Tek 475A** (250MHz) \$650. **Tek 475A/DM44** (250MHz, multimeter) \$725. **Tek 466** (100MHz, storage) \$600. All with bright CRTs; excellent condition, warranty. Pepper Systems, 214-353-0257.

**POWER SUPPLIES, ETC.:** **HP 6237B** triple output: 0-18V, 1A; 0-20V, .5A dual tracking \$375. **HP 6253A** 0-20V, 3A dual tracking \$325. **HP 6255A** 0-40V, 1.5A dual tracking \$325. **HP 6443B** 0-120V, 2.5A \$350. **Tek PS 503A** triple output \$175. **Xentek** extreme isolation transformers for clean power: 5 kVA, 2.5 kVA, etc., starting at \$150. Excellent condition, warranty. Pepper Systems, 214-353-0257 Fax 214-902-9511.

**TEKTRONIX PLUG-INS:** **AM 502, 7A22** high-sensitivity differential amplifiers \$350, \$290. **AM 503 & A6302** current probe & amplifier \$850. **FG 504** 40MHz function generator \$675. **TR 503** tracking generator \$850. **5D10** waveform digitizer with readout \$295. **7CT1N** curve tracer \$350. **7D20** digital storage \$650. **7S12, S-6, S-52** time domain reflectometer \$1,350. **7S14** 1GHz sampler \$575. Excellent condition! Mainframes and many other plug-ins available too. All with warranty. Pepper Systems, 214-353-0257.

**NETWORK ANALYZER** **HP 8505A, HP 8503A, HP 8501A** - complete RF network analyzer system in perfect working condition, \$3,975. ISA, PO Box 6955, Laguna Niguel, CA 92607. 714-488-0010, Fax: 714-488-0299, E-Mail: sklar@cerfnet.com

**WATTMETERS** URM-120, 2-1000 MHz, 10-1000W, three couplers, meter, case, manual, 10 lbs. \$140. Add shipping. **Tartan Electronics, Box 36841, Tucson, AZ 85740-6841, 520-577-1022.**

## SECURITY

**MILITARY COMPONENTS** wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. **Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.**

**PROFESSIONAL ALARM** control panels and all equipment. For a free catalog: voice or fax: 908-840-1390.

**SEC Sun Equipment Corporation**  
P. O. Box 97903, Raleigh, NC 27624-7903  
Test Equipment for Cost-Minded People

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**PS-303 \$159.00**  
0-30VDC, 0-3A, 0.02%+2mV line regulation, 0.02%+3mV load regulation, 1mVrms noise & ripple, Short circuit/overload protection; constant current/voltage (CC/CV).  
**PS-305 \$214.95** dual, tracking  
**PS-305 \$219.95**, 0-30VDC, 0-5A.

**PS-305D \$399.95**, dual, tracking.  
**\$110 \$289.95** 0-60VDC, 0-3A.  
**\$112 \$399.95** 0-60VDC, 0-5A.  
**\$108(810) \$549.95(\$699.95)** 0-60VDC, 0-3A(5A), dual, independent tracking. Low ripple.  
**\$102(810) \$399.95(\$489.95)** triple outputs, 0-30V/0-3A(5A) x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection.  
**PS-1610S(\$107) \$289.00(\$399.95)** 0-16VDC(0-30VDC), 0-10A.  
**PS-2243(2245) \$139.00(\$159.00)** 0-12/0-24VDC, 3A(5A).  
**\$200(820) \$179.95(\$239.95)** 0-30VDC(digital meter), 0-3A(5A).  
**\$210(8211) \$199.95(\$259.95)** two digital meters.  
**\$202(8203) \$499.95(\$549.95)** digital display, triple outputs - dual 0-30VDC/0-3A(5A) & a fixed 5VDC/3A; independent tracking operation; constant current and constant voltage (CC/CV).

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**SM-6225B/C \$1999.95**  
Freq Range: (AM)490kHz, (FM) 10-11.4MHz, Accuracy: ± 0.1%  
Marker: (AM)455kHz, ± 5kHz, ± 10kHz, (FM)10.7MHz, ± 7.5kHz, ± 150kHz.

**STEREO SCOPE OS-7505B \$369.00** trigger, 0-10MHz.

**ALIGNMENT SCOPE OS-7001A \$369.00** 0-200kHz

### AM/FM STD SIGNAL GEN.

**SG-4110A \$1799.00**  
Freq: 100kHz-110MHz  
Display: 6-digit LED  
Accuracy:  
≤±(5x10-5±1 count)  
Resolution: 100Hz [100-34.999MHz]; 1kHz [35MHz-110MHz].  
Output: -19dBu, -99dBu, 1dB steps. Impedance: 50Ω VSWR 1.2.

### NTSC TV COLOR BAR PAT. GEN.

**CPG-1366A \$159.95**, VHF NTSC;  
Freq: 45.75, 175.25, 187.25MHz.  
RF Output: 10mV.  
Impedance: 75 Ohm;  
Video Output: BNC, 1Vp-p.  
**CPG-1367A \$159.95**, VHF PAL.

### SWR/RF/mW POWER METER

**310 \$89.95**  
Freq. Range: 1.8-150MHz.  
RF Power: 0.4W/20W/200W  
SWR Measure: 1.0 ~ 4W min.  
Accuracy: 5%-10%; SO-239 plugs  
Insertion Loss: 0.3dB.

**Input/Output Imp.: 50Ω.**

**320 \$89.95**, 130-250MHz.

**330 \$119.95**, 1.8-520MHz.

**SWR-3P \$26.95** 1.7-150MHz;

**RF Power: 0.5-10W, 0.5W-100W.**

**SWR-2P \$22.95**, 1.7-30MHz, RF Power: 0.5-10W.

### mW RF Power Meter 340 \$219.00

1.8-500MHz, RF power: 20mW/200mW/2W; Imp.: 50Ω; Accuracy: ±10% full scale, N-type connector, SWR<1.5.

### VHF/UHF ATTENUATORS

**RT-8815 \$199.00**, VHF, 500MHz, 81dB, 50Ω, 0.5W.  
**RT-8815U \$359.00**, UHF, 950MHz, 81dB, 75Ω, 0.5W.  
**RT-8817 \$199.00**, VHF, 500MHz, 81dB, 75Ω, 0.5W.  
**RT-8817U \$359.00**, UHF, 950MHz, 81dB, 75Ω, 0.5W.  
**085E-2 \$499.00**, UHF, 950MHz, 61dB, 50Ω, 0.5W.  
**087E-2 \$499.00**, UHF, 950MHz, 61dB, 75Ω, 0.5W.

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8102 \$399.95 \$359.95 triple outputs, 0-30V/0-3A x 2, fixed 5VDC/3A, independent & tracking operation, constant voltage (CV) & constant current (CC), Slave/Master, Serial/Parallel connection.  
**PS-303D \$314.95 \$282.95** dual outputs/tracking, CC&CV. Limited quantity. Full one year warranty.

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1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25"sq. x 1" d. PH is 0.6" d. Both with 6" leads. WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

C-MOUNT model now available. Only 0.9" d

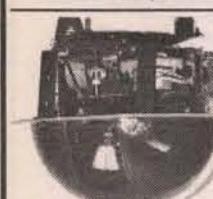
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GM-1000A-PH...\$89 GM-1000A-PH/Audio....\$109  
GM-1000A-CM....\$89 GM-1000A-CM/Audio....\$109**

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f2.0 12mm, 28°.....\$32	5mm, 70°PH.....\$22

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3 x 1/2" microlens CCD using an f1.4 prism, 681 x 582 pixels, 700 lines resolution. 510 lines via RGB outputs. 56dB signal to noise ratio, 15 lux minimum sensitivity. Electronic shutter to 1/2000 second. Full RS-232 remote control. Many auto functions.

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## SCIENTIFIC, 1/2" COLOR CCD CAMERA

**• YC/SVHS output  
• 380K Pixels  
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• 1.5 Lux sensitivity  
• Superior picture**

All parameters adjustable from outside camera! Perfect for microscopy, inspection, capture or surveillance. Features internal or external sync, Interlaced or N/I, Adj. shutter, 1/60 to 1/10000 Sec., Auto White balance with three steps, Auto iris output, C or CS mount, Manual/auto gain or ext. variable gain. BNC video out, 12V@ 250mA pwr, via std. barrel jack. The GM470-C has it all! Aluminum housing. Size: 50mm W x 50mm H x 145mm L  
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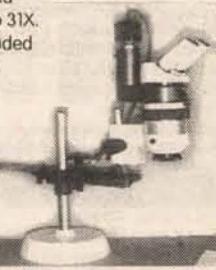
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A truly magnificent instrument. Once you use a WILD all others pale! Magnification with 10X wide field eyepiece smoothly zooms from 6X to 31X. Working distance is 91mm. With included 0.5 objective the working distance is 156mm. Includes base shown, Panasonic WV-CD50 B&W mini CCD camera and Fiber optic ring light. Complete video microscopy system with one of the worlds finest microscopes. Like new condition. Other camera options available. **\$2295.00**



## C-MOUNT, CCD IMAGE INTENSIFIER, a MINI HAND HELD VIEWER ALSO.

Our EXCLUSIVE GM-15K, U.S. made 2nd GEN. If system provides up to 15,000X gain. Add true night vision and super IR capability to any quality CCD camera. Installs between camera & your C-mount lens! Useful as a hand held viewer with our eyepiece & battery holder. Makes your intensifier twice as useful. One of the smallest viewers available! Truly fits in the palm of your hand.

Size: 2" d x 3.4" l **GM-15K.....\$99**

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**SPECIFICATIONS:**  
DC Power: 4.5 - 9V, @65mA  
Power out: 4.5mw max.  
Range: 400-800 Meters  
Glass Collimator  
Size: 0.41" diam. x 0.7"



Shown Actual Size  
The best value for commercial, Subminiature, laser modules. Glass collimating lens provides 1.5mRad performance. (divergence comparable to HeNe lasers.) Wide input, internal surface mount, 4.5 to 9VDC power supply. Machined brass for excellent thermal characteristics.

## Exclusive "LAB STYLE" LASERS, 650nm and 635nm, Rugged, Dependable.

**One year warranty.** Adjustable X and Y beam position. Aircraft aluminum housing. Internal battery and on-off switch included. Makes a super pointer. 7.5d x 2.75" l **SALE.... 650nm \$69, 635nm \$99**

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also includes external screw on, close up lens. Like New, 12.5mm to 75mm, standard C-Mount. Works well with any C-mount camera. A superior lens normally costing >\$350

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**NOW TWO C-MOUNT CAMERAS,** The popular, super sensitive, GM410 or the general purpose GM412. The GM-412 specs: B&W, size 1.5"sq. X 2.4"l, 250,000 Pixels, 380 Lines Resolution, Sensitivity 0.3 Lux. The GM410 specs: size only 1.5" SQ. x 1.6"l, >270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX.

Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE. GM-410 has a BNC. Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform ANY camera in this magazine. Multi-lens options are available to exploit their superior performance.

**GM412 less lens.....\$139ea.**

**GM410 less lens.....\$169ea.**

**Ultra fast 16mm, f1.6, (15°)....\$39ea. Gen'l 4mm, 80°....\$32ea.  
for Low 8mm, f1.3, (30°)....\$49ea. purpose 8mm, 40°....\$32ea.  
Light Use 4mm, f1.4, (56°)....\$49ea. std. light 12mm, 28°....\$32ea.**

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Incredibly only 0.95" x 0.79" x 0.45" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. Shown actual size.

Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned ready to receive on cable

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### SUPER BATTERY Number Two!

**12V @ 12.5 AH SEALED LEAD ACID** Each pack consists of six, 2 Volt cells. Excellent condition. Perfect for robotics and other high drain applications. Size: 6.25"l x 5.75" h x 4.25" d

**\$12ea., 4 for \$39, 10 for \$79**

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## ULTRA RESOLUTION & SENSITIVITY, B/W, 1/2" CCD

Type GM-600, 425K pixels, 600 Lines res. < 0.02LUX sensitivity. Access all operating parameters from outside the camera! Adjustable shutter speed, gain, auto/man. gain, ext. sync. and gamma. 12VDC powered. Dual mounts. Sony CCD! Perfect for use with the GM15K above.

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**AN/PVS-2, U.S. made Gen. 1, Starlight scope,** complete system includes: transit case Depot refurbished. Excellent condition. High gain 30K to 50K MIL spes, three stage, cascade intensifier with automatic brightness control, Super, 95mm, 4 pwr. AA batteries, 17.5"l x 3.5" d, 7.7" h at center. Elcan mount available. **Special Price.....\$695ea. Elcan Mount.....\$75**

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Full scale 0.225" range. Comprised of PMT based optical camera and control unit. Capable of measuring displacement, motion and elongation. Measurement is non contact thus eliminating any change in the target dynamics. Operation is achieved by locking onto a target area which has a contrasting property. LIKE NEW condition. Includes heavy duty wheeled transit case for system. Analog outputs for waveform analysis and direct digital display. Originally \$50K+ **NOW \$895**

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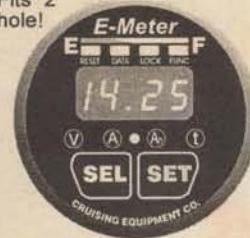
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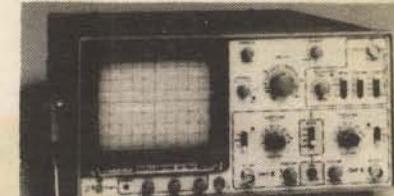
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Enclosed in a black hemisphere housing with a red dome, you only need to press the top for instant voice reporting of the hour and minute, and whether it is AM or PM.

It can be set to announce hourly, or for any alarm time, with three different alarm sounds: beep, cuckoo, or rooster. A "snooze" function and volume adjustment are additional features.

It should be made clear that this is not a design made from junk-box parts, or even parts you can buy independently. Many custom molded plastic and rubber parts, and stamped metal parts, are supplied. The printed circuit board, also supplied, has the "brain" — a custom integrated circuit — built right onto the board.

The benefit of building this project from the \$14.95 Model AK-210 Talking Alarm Clock Kit (see Source) is the *Assembly and Instruction Manual* that not only guides you through a step-by-step assembly, but also is educational. You'll also have the pride of showing off a unique clock you have built.

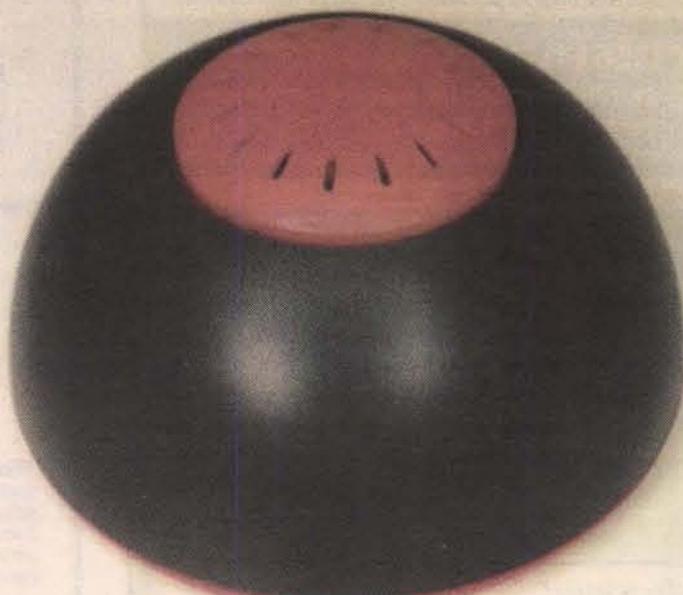
If you build this kit, you'll want to read this review for some details not explained in the kit instructions. Also, I describe some slight difficulties I had in construction that may save you some time or effort.

#### Background

The dictionary defines time as a "measure of duration" and gives examples of seconds, minutes,

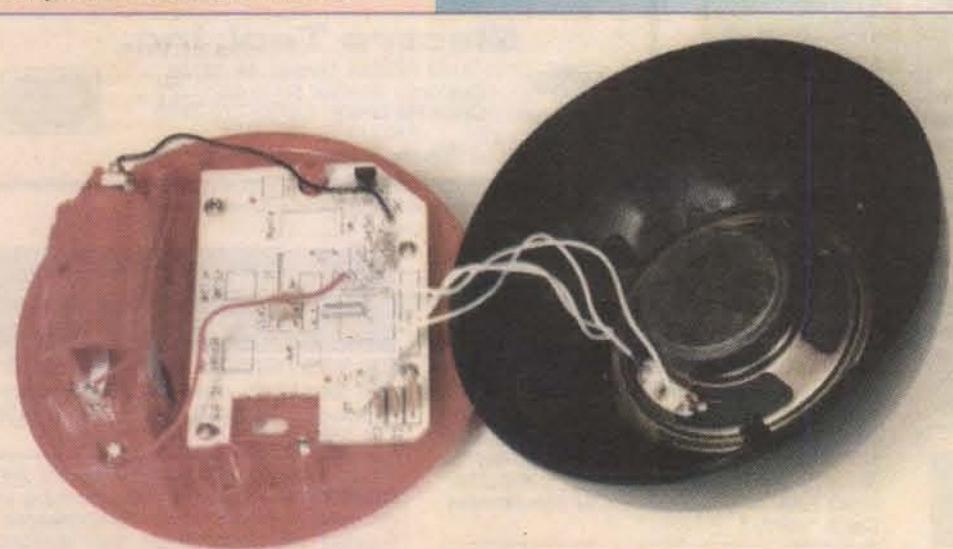
# Build the AK-210 Talking Alarm Clock

by Fred Blechman



The AK-210 is housed in a 4" diameter black hemisphere with a red dome on top. The dome is actually a switch. No other controls are visible.

This easy-to-build kit includes all the components — including many custom parts — to build a modern design talking alarm clock.



A printed circuit board mounts on the plastic base. The upper hemisphere contains the speaker and dome switch.



The LCD time display and all controls except the dome switch are underneath the clock.

hours, days, years, and ages. Since the dawn of the human race, people have used various standards to indicate the passage of time, and various devices to measure present time.

Using sundials, the position of the sun in the sky allowed civilizations to roughly estimate the time of day. The phases of the moon roughly established months. As mechanical clocks were developed to replace sundials, sand clocks, and water clocks, time discrimination became more precise, and various new standards were established.

For example, a portion of the year (Ephemeris Time), atomic resonance (Atomic Time), or rotation of the earth (Sidereal Time) are a few examples of today's attempts to establish standard time periods.

In 1956, the International Committee of Weights and Measures defined the basic unit of time as the "second" and made it equal to  $1/31,556,925.9747$  of the tropical year 1900. It was necessary to pick a specific year since each return of the sun to the vernal equinox decreases by about .0053 seconds.

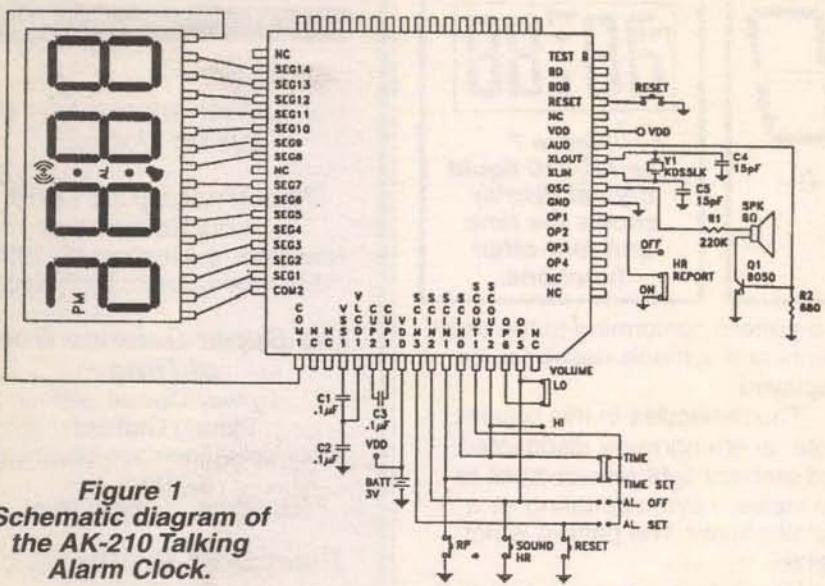
See the references at the end of this article, or check the Internet or your local library for more details.

#### Clocks

All instruments used to measure the passage of time must have a time reference built into them. Figure 1 shows the schematic diagram of the Model AK-210 Talking Clock, which uses a tiny vibrating crystal as its time standard. This is shown as Y1 in the schematic.

Crystals are used in electronic oscillator circuits to provide a stable frequency of oscillation. A crystal can be thought of as the electronic equivalent of a mechanical tuning fork.

When the tuning fork in Figure 2 is struck (excited), it will vibrate at only one frequency producing a clear, undistorted tone. When the crystal in the AK-210 clock circuit is excited (struck by an electronic



**Figure 1**  
Schematic diagram of  
the AK-210 Talking  
Alarm Clock.

pulse), it will also vibrate at only one frequency, as illustrated in Figure 3.

The crystal supplied with the kit is designed to vibrate at a frequency of 32,768 Hz (Hz = Hertz = cycles per second). By continually dividing this frequency by 2, the frequency standard of 1.0000 Hz is obtained, as can be seen in Table 1.

Once the time standard of 1.000 seconds has been established, the custom integrated circuit attached to the AK-210 printed circuit board can calculate minutes, hours, and seconds. This information is then used to display digits or activate the appropriate speech.

This same built-on-board integrated circuit also checks to see if the time set in the alarm memory circuits has been reached. If the alarm time is the same as the time of day, the pre-selected alarm sound (beep, cuckoo, or rooster) will be activated. The alarm sound gets louder and repeats until it is deactivated.

### Making the Clock Talk

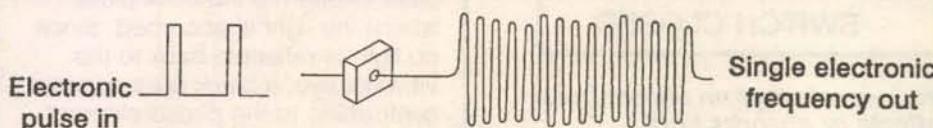
There are numerous ways to record and reproduce speech. Records, tapes, CDs, video, and digital memory circuits are just a few well-known examples. The AK-210 uses words stored in digital memory to "speak" the time of day. Table 2 shows how many words are needed to verbally give the correct time.

The words in Table 2 are combined in certain

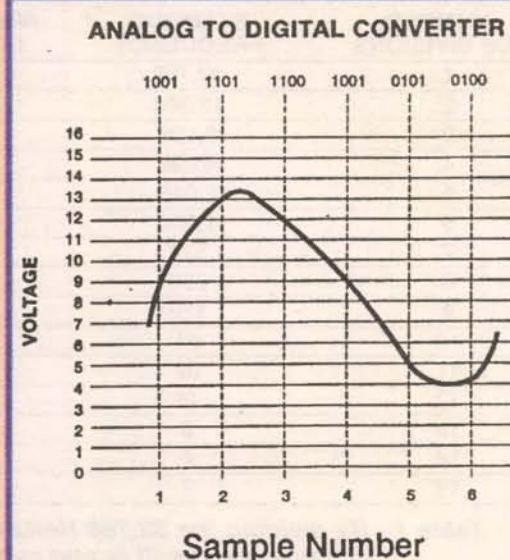
ways to represent the correct time of day. For example, 11:14 in the morning would be "Eleven" "Four" "Teen" "—" "Oh" "Clock" "—" "A" "M."

Note there are two pauses that separate words to improve the speech quality.

In practice, these words are converted from a continuously changing voltage (analog) into a series of high (1) or low (0) voltage pulses (digital) by an analog-to-digital (A-to-D) converter. See Figure 4. When converting an analog signal to digital numbers, the constantly changing waveform is sampled, and each sample is converted electronically to a digital format — in this

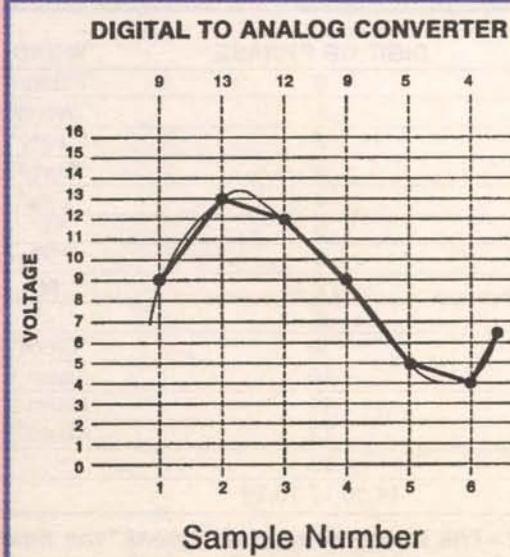


**Figure 3 - When a crystal is excited, it vibrates at only one frequency.**



Sample #	Voltage	Analog	Digital
1	9	1001	
2	13	1101	
3	12	1100	
4	9	1001	
5	5	0101	
6	4	0100	

**Figure 4 - Sampling an analog signal to convert to digital binary code.**



DIGITAL	ANALOG
1001 = 1x8 + 0x4 + 0x2 + 1x1 = 9	
1101 = 1x8 + 1x4 + 0x2 + 1x1 = 13	
1100 = 1x8 + 0x4 + 0x2 + 0x1 = 12	
1001 = 1x8 + 0x4 + 0x2 + 1x1 = 9	
0101 = 0x8 + 1x4 + 0x2 + 1x1 = 5	
0100 = 0x8 + 1x4 + 0x2 + 0x1 = 4	

**Figure 5 - Digital binary code converts back to digital sample values.**

case, a four-bit (binary digit) "word."

When only four binary digits ("bits") are used, a decimal count of 0 to 15 is possible. Each bit has a "weight" based on the powers of 2, and only counts if it has a digital 1 value; 0 does not count.

The leftmost of the four bits (the most significant digit) is 2 to the third power, or decimal "8." Moving to the right, the second digit is 2 to the second power, or decimal "4." The next bit to the right is 2 to the first power, or decimal "2." The rightmost bit (the least significant digit) is 2 to the zero power, or decimal "1." If all binary bits are 1 (on), you would add  $8+4+2+1$ , for a total of decimal 15.

Looking at Figure 4, you can see how the analog voltage sampled at nine different points each can be expressed as a four-bit digital word. For example, Sample #5 is 5 volts, which converts to digital 0101. Remembering that each digital 1 represents a power of 2, you evaluate from the left to the right and get  $(0+4+0+1=5)$ .

The digital word samples are then stored in the integrated circuit and, when needed to operate the speaker, convert back to analog voltages electronically by a digital-to-analog (D-to-A) converter as shown in Figure 5.

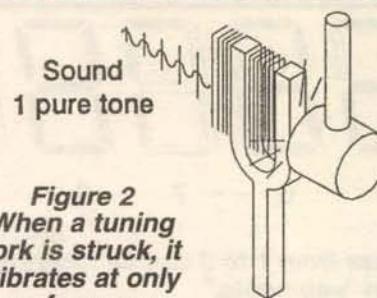
If we say that a 1 means the voltage is present and a 0 means it is not, then 1001 would mean 8 volts is present, 4 volts is not, 2 volts is not, and 1 volt is present, yielding a total decimal value of 9.

After the digital numbers are converted to words, the words are amplified and sent to the speaker. The speaker reproduces the sounds that make the clock speak the time. As supplied, the AK-210 "speaks" only English. However, by special order (see Source), the integrated circuit used comes with words for any one of these foreign languages: Japanese, German, Spanish, Chinese, Italian, French, or Arabic.

### The Visual Display

On the bottom of the AK-210 case is a small window where a four-digit time-of-day and some special symbols are shown using a liquid crystal display (LCD). Each number that appears in this window is made up of the appropriate combination of four vertical and three horizontal "segments," as shown in Figure 6.

For example, the num-



**Figure 2**  
When a tuning  
fork is struck, it  
vibrates at only  
one frequency.



Figure 6 - All decimal numbers from 1 to 0 can be represented by seven "segments."

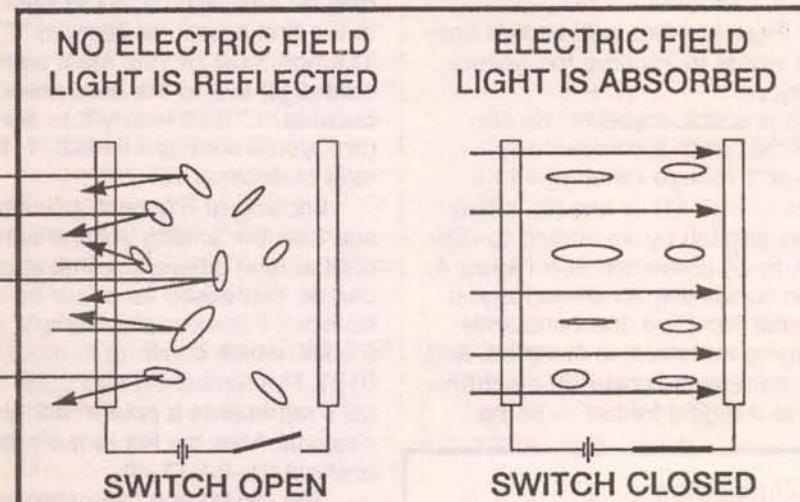


Figure 8 - An electric field determines whether an element of a liquid crystal display reflects or absorbs light.

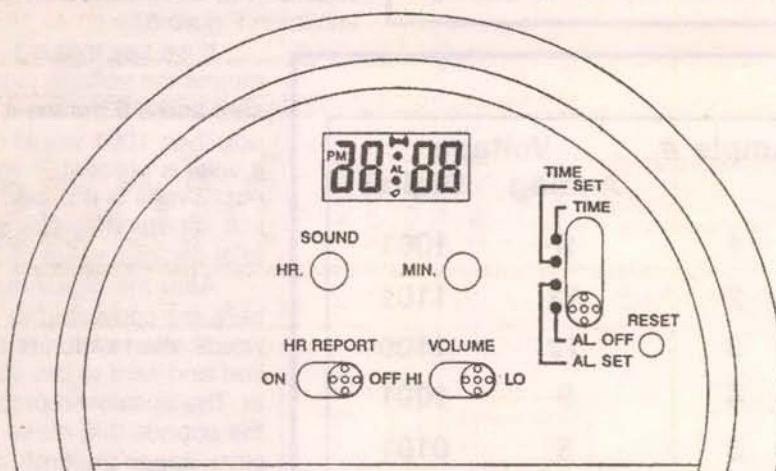


Figure 9 - The display and all the switches are on the bottom of the AK-210.

ber "8" uses all seven segments. The number "3" uses only the two right vertical segments and all the horizontal segments.

Figure 7 shows a close-up of the display with ALL segments and symbols "on." Note that the leftmost digit does not have (or need) the upper left vertical segment, since it never needs to show other than a "1" or a "2" (for military 24-hour time). The kit as supplied uses only 12-hour AM/PM time.

AM is not shown, but PM is. The symbol at the top center is to indicate the hourly announcement

is active. The AL indicates the display is showing the alarm time. The little bell at the bottom center indicates the alarm is active.

### Liquid Crystal Displays

The device used to create the black numbers and symbols on the bottom of the AK-210 is called a liquid crystal. An organic material is placed between two glass plates



Figure 7  
The AK-210 liquid crystal display shows the time and four other functions.

in a pattern conforming to the segments and symbols desired to be displayed.

The molecules in this organic material are normally disoriented, and ambient light reflects back to the viewer's eye, appearing as a metallic luster. The pattern is not visible.

However, as shown in Figure 8, when any of the pattern elements are exposed to an electric field (resulting from a voltage from the clock integrated circuit), the molecules of this element align themselves and allow ambient light to pass through to the back plate, where the light is absorbed. Since no light is reflected back to the viewer's eye, a black area appears conforming to the plated element pattern. This "black" area is much darker than the brighter metallic luster of the unaligned molecules in

For further information on talking clocks:

#### **The Mystery of Time**

by Harry Edward Neal  
New York, J. Messner (C)1966  
190 pages, Junior High level

#### **The Super Science Book of Time**

by Kay Davies and Wendy Oldfield  
New York, Thomson Learning (C)1993  
32 pages, Juvenile level

#### **Electronic Synthesis of Speech**

by Robert Lingard  
New York, Cambridge University Press (C)1985  
149 pages

#### **Build-It Book of Digital Clocks**

by Robert Haviland  
TAB Books, Blue Ridge Summit, PA (C)1986  
344 pages

NUMBER OF DIVISIONS	STARTING FREQUENCY	FREQUENCY DIVIDE BY	FINAL FREQUENCY
1	32,768	2	16,384
2	16,384	2	8,192
3	8,192	2	4,096
4	4,096	2	2,048
5	2,048	2	1,024
6	1,024	2	512
7	512	2	256
8	256	2	128
9	128	2	64
10	64	2	32
11	32	2	16
12	16	2	8
13	8	2	4
14	4	2	2
15	2	2	1

Table 1 - By dividing the 32,768 Hertz crystal frequency by 2, 15 times, the result is one cycle per second.

WORD	DIGIT OR PHRASE	WORD	DIGIT OR PHRASE
"Oh"	0	"Fifteen"	15
"One"	1	"Twenty"	20-29
"Two"	2	"Thirty"	30-39
"Three"	3	"Forty"	40-49
"Four"	4	"Fifty"	50-59
"Five"	5	"A"	A
"Six"	6	"P"	P
"Seven"	7	"M"	M
"Eight"	8	"_"	(Pause)
"Nine"	9	"Clock"	Clock
"Ten"	10	Alarm 1	(Sound of Rooster)
"Eleven"	11	Alarm 2	(Coo-Coo Clock Sound)
"Twelve"	12	Alarm 3	(Beeping Sound)
"Thirteen"	13		
"Teen"	14,16,17,18,19		

Table 2 - The words needed to "speak" the time are contained in the integrated circuit built onto the printed circuit board.

### Source

The Model AK-210 Talking Alarm Clock Kit is available only from C & S Sales, Inc., 150 W. Carpenter Ave., Wheeling, IL 60090. The kit price is \$14.95. Add \$5.00 North America shipping and handling. IL residents add 8.25% sales tax. North American orders: (800) 292-7711. For information or foreign orders call (847) 541-0710.

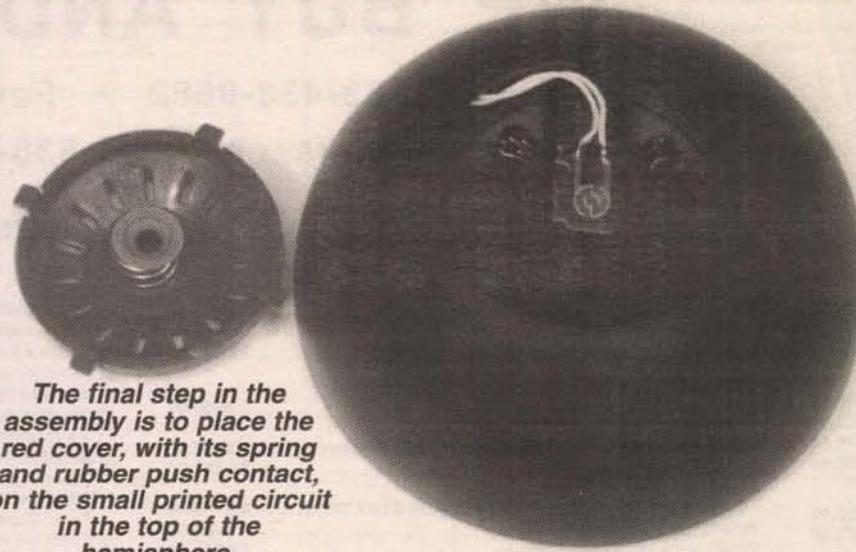
the unactivated area of the display.

## Assembly

An excellent well-illustrated 16-page *Assembly and Instruction Manual* is included in the AK-210 kit. The kit includes wire and solder, as well as many special parts. The only things you'll need to supply (other than a soldering iron and pliers) are two "AA" 1.5-volt batteries. Each of the special molded or stamped parts is illustrated and identified in the manual, and each has its own part number if replacement is necessary.

Assembly is straightforward. The only parts soldered to the printed circuit board (which is nicely silk-screened to show all part locations) are two resistors, five capacitors, one transistor, the crystal, three jumpers, and six wires that go to the battery compartment, speaker, and dome switch. All the wires are pre-cut to length and ends stripped, making it even easier. And there was more than enough solder supplied!

The only difficulty encountered in construction was with the metal parts. In order to be installed properly, two of the four battery contacts had to be bent about 135° instead of the 90° shown in the assembly



*The final step in the assembly is to place the red cover, with its spring and rubber push contact, on the small printed circuit in the top of the hemisphere.*

illustrations. Also, the contact fingers on all three switches had to be bent upward to make better contact with the printed circuit board after assembly.

## Testing

To assure proper operation before final assembly, the AK-210 is tested by installing two AA batteries in the battery compartment to see if the LCD segment and symbols all display. If not, you might have to adjust the physical alignment of the LCD and its flexible multi-contact

strip, called a "zebra."

Figure 9 shows the switches and display on the bottom of the clock. With the LCD operating, you test out the various switch positions to see that you can set the present time and the alarm time. You also test the beep, cuckoo, and rooster alarm sounds, as well as the hourly announcement and volume settings. This is all adequately described in the manual.

Once testing is satisfactory, the dome switch (a small PCB contacted by pressing a rubber conductive cup) is installed, and the dome

cover placed in position. Done!

## Using

Simply tap the dome anytime and the clock will literally tell you the time. If the alarm is set, the sound you selected starts at alarm time and gets louder if you don't turn it off by moving a switch on the bottom. If you tap the dome switch instead, it acts as a "snooze alarm" and comes back on in 10 minutes.

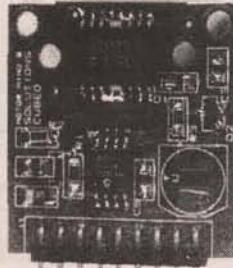
If you set it for hourly announcements, it tells the time at the beginning of every hour. Setting the display for present time or alarm time involves setting a switch to the proper position and pressing an HOUR and MINUTE rubber button contact at the bottom of the clock to set the time. The RESET button sets it to 12:00 AM.

## The Bottom Line

All controls (except the dome switch), and the display, are on the bottom of the AK-210 clock. All you see when the clock is on a table is a 4" diameter black hemisphere with a red top — very modern. You'll have a lot of people ask, "What's that?" Tell them to gently press the top red dome, and watch them jump when it "tells" them the time! NV

# All New Products

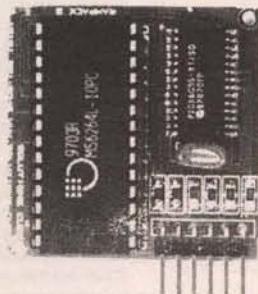
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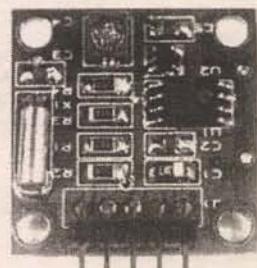
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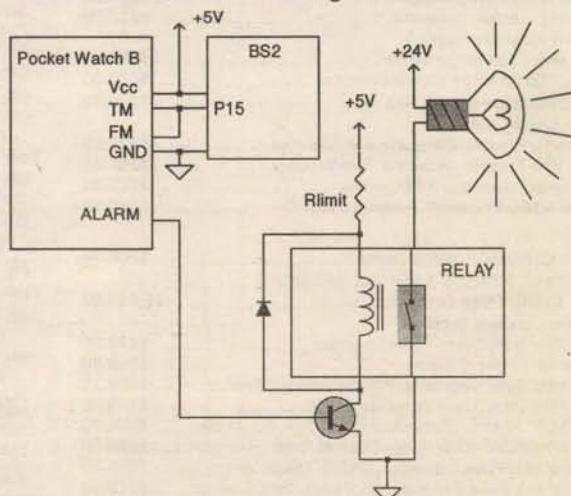
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SEROUT FM,84,[\$55,\$18,\$03,\$0E] 'Alarm on 15min. every 4hrs.
SEROUT FM,84,[\$55,\$14] 'Turn on alarm
END:
```

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TEK 7A18 75 MHz Dual Trace Amplifier	\$100.00
TEK 7A22 1 MHz High CMRR Differential Amplifier	\$300.00
TEK 7B53A 100 MHz Dual Time Base	\$175.00
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series	\$375.00

### ABOVE 100 MHz

TEK 475A 250 MHz Dual Trace Oscilloscope	\$900.00
TEK 7104 1 GHz Oscilloscope, with 7A29, 7A29-04, 7B10, 7B15	\$4,500.00
TEK 7844 400 MHz Dual Beam Oscilloscope frame	\$750.00
TEK 7844 400 MHz Dual Beam Oscilloscope with 7A24, 7A26, 7B80, 7B85	\$1,250.00
TEK 7854 400 MHz Waveform Processing Oscilloscope frame	\$1,250.00
TEK 7904A 500 MHz System, with 7A24, 7A26, 7B92A	\$1,250.00
TEK 7904A 500 MHz System, with 7A24, 7A26, 7B80, 7B85	\$1,250.00
TEK 7A13 105 MHz Differential Comparator	\$225.00
TEK 7A19 600 MHz Single Trace Amplifier	\$150.00
TEK 7A24 400 MHz Dual Trace Amplifier	\$300.00
TEK 7A26 200 MHz Dual Trace Amplifier	\$175.00
TEK 7B15 1 GHz Delaying Time Base	\$450.00
TEK 7880 400 MHz Delayed Time Base	\$175.00
TEK 7B85 400 MHz Delta Delaying Time Base	\$175.00
TEK 7B92A 500 MHz Dual Time Base	\$275.00

### STORAGE

TEK 7633 100 MHz Storage Oscilloscope frame	\$650.00
TEK 7633 100 MHz Storage Oscilloscope with (2) 7A26, (1) 7B92A	\$1,000.00

### PROBES

HP 1122A Probe Power Supply	\$200.00
TEK 1101 Accessory Power Supply, for FET probes	\$250.00
TEK P6101A 34 MHz 1X Modular Probe, 2m length "NEW"	\$25.00
TEK P6108A 100 MHz 10X Modular Probe, 2m length "NEW"	\$50.00
TEK P6201A 900 MHz 1X/10X/100X FET Probe	\$450.00
TEK P6202A 500 MHz 10X FET Probe	\$300.00
TEK P6701-opt.02 O/E Converter, 450-1050 nm/0-1 mW: DC-700 MHz, ST conn.	\$675.00

### CALIBRATION

TEK CG5001-opt.01/TM5006 Programmable Oscilloscope Calibrator, with power module	\$6,000.00
TEK CG551AP/TM506A Oscilloscope Calibrator, with pulse head & power module	\$2,500.00

## WAVEFORM GENERATORS

### FUNCTION

HP 3310A 5 MHz Function Generator	\$250.00
HP 3310B 5 MHz Function Generator, monocycle & var.phase trigger	\$325.00
HP 3312A 13 MHz Function Generator	\$750.00
KROHN-HITE 2000 30 MHz Function Generator	\$600.00
TEK DDS501 Digital Delay & Burst Gen., for function & pulse gen's	\$275.00
TEK FG501 1 MHz Function Generator, TM500 series	\$225.00
TEK FG503 3 MHz Function Generator, TM500 series	\$250.00
TEK RG501 RAMP Generator, TM500 series	\$225.00
WAVETEK 186 5 MHz Phaselock Function Generator	\$350.00

### PULSE

BERKELEY NUCLEONICS 7085B Digital Delay Generator, 0-100 μs, 1 nS res., 5 Hz-5 MHz	\$900.00
HP 214B-001 10 MHz Pulse Generator, 50 V/50 ohms, counted burst opt	\$2,000.00
HP 8005B 20 MHz Dual Output Pulse Generator	\$450.00
HP 8007B 100 MHz Pulse Generator	\$650.00
HP 8012B 50 MHz Pulse Generator, variable transition time	\$600.00
HP 8015A 50 MHz Dual Output Pulse Generator	\$700.00
HP 8015A-002,007 50 MHz Dual Output Pulse Gen., burst option	\$800.00
HP 8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator	\$950.00
TEK PG502 250 MHz Pulse Generator, Tr-1nS, TM500 series	\$600.00
TEK PG505 100 kHz Pulse Generator, 80 V peak, TM500 series	\$275.00

### PROGRAMMABLE

HP 8165A-002,003 Prog. Signal Source, 1 mHz-50 MHz, log sweep, rear out	\$2,000.00
TEK AWG5102 Arb.Waveform Gen., 20 MS/s, 12 bits, 50ppm synthesis <1MHz	\$1,400.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option	\$1,900.00
TEK FG5010 Programmable 20 MHz Function Generator, TM5000 series	\$1,200.00
WAVETEK 288 20 MHz Synthesized Function Generator, GPIB	\$1,250.00

## VOLTAGE & CURRENT

### VOLTMETERS

HP 3456A 6-1/2 Digit Voltmeter	\$850.00
HP 3478A 5-1/2 digit Multimeter, HPIB	\$700.00

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### KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB

\$1,200.00

### SOLARTRON 7081 8-1/2 digit Voltmeter

\$3,900.00

### CALIBRATION

FLUKE 343A DC Voltage Calibrator, 0-1100 V, 7 decades, 20 ppm acc.

\$950.00

### FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA

\$450.00

### FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power

\$1,250.00

### FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A

\$3,750.00

### FLUKE 731B DC Reference Standard

\$400.00

### FLUKE 732A DC Voltage Standard

\$2,000.00

### FLUKE A40-series Current Shunts

\$200.00

### FLUKE A55-series AC Thermal Converters

\$300.00

### VALHALLA 2703 AC Volt.Std., 0-120V/10 Hz-100 kHz;120-1200V/10 Hz-1 kHz

\$2,250.00

### VOLTAGE SOURCES

HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A

\$875.00

### CURRENT METERS & SOURCES

HOLT HCS-1AF Primary Current Shunt Set, 0.02/0.2/0.5/2/5/20 Amp

\$750.00

### HP 4140B Picammeter / DC Voltage Source

\$4,000.00

### HP 6177C DC Current Source, to 50V, 500mA

\$500.00

### HP 6181C DC Current Source, to 100 V, 250 mA

\$500.00

### HP 6186C DC Current Source, to 300V, 100mA

\$750.00

### KEITHLEY 225 Current Source, 0.1 uA-100 mA, 10-100 V compliance

\$500.00

### KEITHLEY 414A Picammeter, 0.1 nA-10 mA

\$325.00

### KEITHLEY 486 Picammeter

\$1,500.00

### KEITHLEY 642 Electrometer

\$2,900.00

### TEK CT-5 opt.05 High Current Transformer for P6021/A6302, to 1000A

\$500.00

### VALHALLA 2301 Programmable Single Phase Power Analyzer

\$1,250.00

## IMPEDANCE & COMPONENT TEST

### L.C.R.

### BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH

\$550.00

### HP 4275A-001 5-1/2 digit LCR Meter, 10 kHz-10 MHz, 0-35 V int. bias

\$6,000.00

### STANDARDS

E.S.I. SR1010 Resistance Transfer Standards, 1 ohm-100 K/step

\$700.00

### E.S.I. SR1050-10M Resistance Transfer Standard, 10 Megohms/step

\$2,500.00

### E.S.I. SR1050-1M Resistance Transfer Standard, 1 Megohm/step

\$2,000.00

### GR 1403-SERIES Standard Air Capacitors, 0.1% accuracy

\$150.00

### GR 1406 Standard Air Capacitors, GR900 connector, 0.1% acc.

\$375.00

### GR 1412-BC Decade Capacitor, 50 pF - 1.11115 uF

\$350.00

### GR 1432-U 4-Decade Resistor, 0-111.10 ohms, 0.01 ohm resolution

\$125.00

### GR 1433-J 4-Decade Resistor, 0-1,110 ohms, 1 ohm resolution

\$350.00

### GR 1433-L 4-Decade Resistor, 0-11,110 ohms, 10 ohm resolution

\$350.00

### GR 1433-N 5-Decade Resistor, 0-11,111 ohms, 0.1 ohm resolution

\$400.00

### GR 1433-Q 4-Decade Resistor, 0-1,111.00 ohm, 100 ohm resolution

\$350.00

### GR 1433-U 4-Decade Resistor, 0-11,100 ohms, 0.01 ohm resolution

\$350.0



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HP 204D Oscillator, 5 Hz-1.2 MHz, 5 VRMS, 80 dB step attenuator	\$200.00
HP 209A Sine/Square Wave Generator, 4 Hz-2 MHz, 5 VRMS max.	\$225.00
HP 652A Test Oscillator, 10 Hz-10 MHz	\$250.00
TEK SG502 Sine/Square Osc., 5 Hz-500 kHz, 70 dB step atten., TM500	\$200.00
<b>MISCELLANEOUS</b>	
HP 4437A Step Attenuator, 0-119.9 dB, DC-1 MHz, 600 ohms unbal.	\$175.00
HP 461A Amplifier, 20/40 dB, 1 kHz-150 MHz, 0.5 V/50 Ohms	\$125.00
KROHN-HITE 3103 High/Low Pass Filter, 10 Hz-3 MHz, 24 dB/octave	\$500.00
KROHN-HITE 3342R Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave	\$1,100.00
KROHN-HITE 3750 LP/HP/BP/BR Filter, 0.02 Hz-20 kHz, 6/12/18/24 dB/oct.	\$700.00
ROCKLAND 852 Dual Highpass/Lowpass Filter, 0.1 Hz-111 kHz	\$1,000.00
TEK AF501 Tunable Bandpass Filter / Amplifier, 3 Hz-35 kHz	\$300.00
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series	\$475.00

### RF & MICROWAVE

#### SPECTRUM ANALYZERS

HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 11970Q WR22 Harmonic Mixer, 33.50 GHz	\$1,400.00
HP 11971A WR28 Harmonic Mixer, 26.5-40.0 GHz, for 8569B	\$1,100.00
HP 11971K WR42 Harmonic Mixer, 18.0-26.5 GHz, for 8569B	\$1,100.00
HP 8406A Comb Generator, 1/10/100 MHz increments, to 5 GHz	\$450.00
HP 8444A-059 Tracking Generator, 0.5-1500 MHz, for 8554,8568,etc.	\$1,250.00
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A	\$650.00
HP 8553B/8552B/8443/141 Spectrum Analyzer, 0.1-110 MHz, with tracking generator	\$2,500.00
HP 8565A-100 Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min.res.bw.	\$5,000.00
HP 8569B Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min.res.bw.	\$8,500.00
TEK 119-0098-00 WR42 Single Ended Mixer, 18.0-26.5 GHz, for Tek 491	\$200.00
TEK 119-0099-00 WR28 Single Ended Mixer, 26.5-40 GHz, for Tek 491	\$200.00
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6	\$1,375.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz	\$2,000.00

#### NETWORK ANALYZERS

HP 11664C Defector Adapter, for 8755/6/7	\$200.00
HP 11666A Reflectometer Bridge, 0.04-18.0 GHz, for HP 8755/6/7	\$1,100.00
HP 8505A Network Analyzer, 0.5-1300 MHz	\$3,750.00
HP 8756A/(3)11664A-001 Scalar Network Analyzer, w/(3) det., APC7, 0.01-18 GHz	\$3,750.00

#### SIGNAL GENERATORS

FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res, GPIB	\$2,000.00
FLUKE 6062A Signal Generator, 0.1-2100 MHz, 10 Hz resolution	\$5,500.00
FLUKE 6070A Synthesized Signal Generator, 0.2-520 MHz, 1 Hz res.	\$2,000.00
GIGATRONICS 600/10-18 Synthesized Source, 10-18 GHz, 1 MHz res., GPIB	\$2,600.00
GIGATRONICS 605/10-18 Synthesized Source, 10-18 GHz, 1 kHz res., GPIB	\$3,000.00
GIGATRONICS 840-01 Freq. Doubler, 26.5-40 GHz (WR28) out, 13-20 GHz in	\$2,000.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm	\$3,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs	\$5,000.00
GIGATRONICS 910/12-18,opt.6,14,16 Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., OCXO	\$3,500.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio	\$750.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm	\$4,250.00
HP 8640B-001,002,003 Signal Gen., 0.5-1024 MHz, AM, FM, var. audio osc.	\$2,250.00
HP 8654A Signal Generator, 10-520 MHz, calibrated AM & uncal. FM	\$550.00
HP 8656A Signal Generator, 0.1-990 MHz, 100 Hz res, AM, FM, HPIB	\$2,900.00
HP 8660C/8660B-002 Synth. Sig. Gen., 1-2600 MHz, FM / Phase mod. w/86635A	\$3,250.00

#### SWEEP GENERATORS

HP 8600A Digital Marker, for HP 8601A	\$400.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled	\$400.00
HP 8620C Sweep Oscillator Frame	\$550.00
HP 8620C-011 Sweep Oscillator Frame, HPIB programmable	\$675.00
HP 86222A-002 RF Plug-in, 10-2400 MHz, +13 dBm levelled, 70 dB atten.	\$1,600.00
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled	\$675.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled	\$500.00
HP 86242D-004,008 RF Plug-In, 5.9-9.0 GHz, +10 dBm levelled	\$500.00
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm levelled	\$1,100.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled	\$675.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled	\$800.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled	\$800.00
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled	\$1,750.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled	\$2,000.00

WAVETEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvd.	\$1,500.00
<b>POWER METERS</b>	
ANRITSU MP-81B/ML-83A Power Meter, 75-110 GHz (WR10), -20 to +20 dBm	\$2,500.00
ANRITSU MP-82B/ML-83A Power Meter, 90-140 GHz (WR8), -20 to +20 dBm	\$3,250.00
BOONTON 4200-01A,03/4-A x2 Dual Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors	\$1,500.00
BOONTON 42B/41-4B Analog Power Meter, with 1 MHz-12 GHz sensor	\$375.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor	\$500.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm	\$375.00
HP 432B/8478B Digital Power Meter, 10 uW-10 mW linear scale, 0.01-18GHz	\$500.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz, -30 to +20 dBm	\$1,000.00
HP 435A/8482H Power Meter, 0.1-4200 MHz, -10 to +34 dBm	\$1,150.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22, for 435/6/7/8	\$1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40 GHz, for 432 series	\$350.00
<b>RF MILLIVOLTMETERS</b>	
BOONTON 9200A-01 RF Millivoltmeter, 10 kHz-1.2 GHz, GPIB	\$900.00
BOONTON 92B-opt.05 RF Millivoltmeter, 10 kHz-1.2 GHz, 75 ohm scale	\$500.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB	\$875.00
<b>AMPLIFIERS, MISCELLANEOUS</b>	
BOONTON 82AD-opt.01A Modulation Meter, AM, FM, 10-1200 MHz, GPIB	\$900.00
HP 465A Amplifier, 20/40 dB, 5 Hz-1 MHz, 1/2 Watt/50 Ohms	\$125.00
HP 8447A-001 Dual Amplifier, 0.1-400 MHz	\$450.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output	\$750.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz	\$3,750.00
HP 8901B-001 Modulation Analyzer, 150 kHz-1300 MHz, rear panel input	\$6,750.00
HP 8970A Noise Figure Meter	\$6,000.00
HUGHES 1177H01F000 TWT Amplifier, 2.0-4.0 GHz, 10 Watts output	\$1,500.00
HUGHES 1177H02F000 TWT Amplifier, 4.0-8.0 GHz, 10 Watts output	\$1,500.00
M.P.D. LAB2-1020-2A Amplifier, 34 dB, 1.0-2.0 GHz, 2 Watts	\$800.00
M.P.D. LAB2-714-3A Amplifier, 34 dB, 0.7-1.4 GHz, 3 Watts	\$800.00
MICROWAVE SEMI.CORP. MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC	\$325.00
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz	\$6,000.00
<b>COAXIAL &amp; WAVEGUIDE</b>	
AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) "NEW"	\$95.00
FXR/MICROLAB S3-02N Triple Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f)	\$125.00
GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz	\$400.00
GR 900-Q GR900 14mm Interseries Adapters	\$125.00
HP 11589A Bias Network, 0.1-3.0 GHz, N(f/l)	\$350.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7	\$450.00
HP 11612A Bias Network, 45 MHz-26.5 GHz, APC3.5	\$550.00
HP 11691D Directional Coupler, 22 dB, 2.2-18 GHz	\$450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz	\$800.00
HP 11721A Freq. Doubler, 50-1300 MHz in/100-2600 MHz out	\$400.00
HP 33330B Crystal Detector, 0.01-18 GHz, neg. pol., SMA(m)/SMC(f)	\$135.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz	\$275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz	\$275.00
HP 8470B-012 Crystal Detector, 10 MHz-18 GHz, neg. pol., N(m)	\$250.00
HP 8491A-030 30 dB Attenuator, DC-12.4 GHz, 2 Watts, N(m/f)	\$50.00
HP 8494G-002 Programmable Step Attenuator, 0-11 dB, DC-4 GHz, SMA	\$400.00
HP 8495G-002 Programmable Step Attenuator, 0-70 dB, DC-18 GHz, SMA	\$300.00
HP 8495H-002 Programmable Step Attenuator, 0-70 dB, DC-18 GHz, SMA	\$400.00
HP 8497K-004 Programmable Step Attenuator, 0-90 dB, DC-26.5 GHz	\$750.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz	\$350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	\$500.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz	\$275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz	\$425.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz	\$650.00
HP R375A WR28 Variable Attenuator, 0-20 dB, 26.5-40 GHz	\$375.00
HP R422A WR28 Flat Broadband Detector, 26.5-40 GHz	\$400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz	\$500.00
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz	\$450.00
HP R914B WR28 Moving Load, 26.5-40 GHz	\$300.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz	\$900.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz	\$650.00
HP X870A WR90 Slide Screw Tuner	\$150.00
HUGHES 45111H-2000 WR28 Isolator, 25 dB, 26.5-40 GHz	\$450.00
HUGHES 45113H-1000 WR19 Isolator, 25 dB, 40-60 GHz	\$650.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz	\$900.00
HUGHES 47316H-1111 WR10 Tunable Detector, 75-110 GHz, positive polarity	\$750.00
HUGHES 47323H-1211 WR19 Flat Broadband Detector, negative, 40-60 GHz	\$650.00
HUGHES 47974H-1000 WR15 SPST PIN Switch, 250 MHz speed, 60-62 GHz response	\$375.00
<b>LOGIC</b>	
HP 10343B/10269C SCSI Bus Preprocessor, w/probe intfc., for 1630 series	\$300.00
HP 5005A Signature Multimeter	\$350.00
HP 8170A-002 Logic Pattern Generator, 2 MB/s, address driver option	\$1,200.00
TEK 1240D/2/1 10-channel 50 MHz D/A Module for 1240, without probes	\$50.00
TEK 30DM08 80286 Probe, for Tek Prism	\$50.00
TEK DP186P 80186 / 80188 Probe, for Tek 1230	\$50.00
TEK DP286P 80286 Probe, for Tek 1230	\$50.00
TEK DPHC11 68HC11 Probe, for Tek 1230	\$50.00
TEK P6454 100 MHz Clock Probe, for DAS	\$50.00
<b>COMMUNICATIONS</b>	
HP 4972A LAN Protocol Analyzer	\$1,500.00
HP 59401A HPIB Bus Analyzer	\$700.00
TEK 1410R NTSC Gen., w/SPG2 sync generator, TSG7 color bars	\$1,000.00
TEK 1411R PAL Gen., w/SPG12 sync; TSG11 color bars; TSG13 linearity	\$1,000.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG15, TSG16	\$1,400.00
TEK 1411R PAL Test Gen., w/SPG12, TSG12, TSG13, TSG15, TSG16	\$1,600.00
TEK 1411R-opt.04 PAL Test Gen., w/SPG12, TSG12, TSG13, TSG15, TSG16	\$1,600.00
SPG12, TSG11, TSP11, TSG13, TSG15, TSG16	\$1,900.00
TEK 147A NTSC Test Signal Generator, with noise test signal	\$800.00
TEK 148 PAL Insertion Test Signal Generator	\$800.00
TEK 1750 NTSC Waveform / Vector Monitor	\$2,750.00
TEK 520A NTSC Vectorscope	\$750.00</

# SPECIAL PROJECTS



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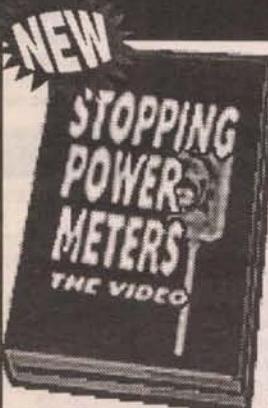
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# Software Wizardry

By Harry Helms



Windows NT introduced something called the registry. The registry was a central hierarchical database containing configuration data for the entire PC. This was in contrast to previous versions of Windows, where scattered .INI files contained configuration data. The registry was intended to be a "one-stop" location for configuration data and also to get around some of the limitations of .INI files (like being restricted to a maximum of 64K on some PCs).

Registry entries can include data, like text strings, not supported by .INI files. And by storing all configuration data in one place, the registry is easier to back up and restore than .INI files. Because of these advantages, the registry was incorporated into Windows95.

You've probably manipulated the registry several times without realizing it. Every time you install (or uninstall) software in Windows95, you're manipulating the registry. Have you changed the color of your Windows95 desktop or the display resolution? Even that alters the registry.

However, the registry doesn't entirely replace .INI files. (There's still a SYSTEM.INI file for compatibility with Windows 3.1, for example.) And the registry introduces some new problems of its own. For example, ActiveX controls used in Windows software are stored in the registry. A corrupted registry entry can bring an application (or even your PC) to a screeching halt. Installing new software often alters registry entries, so troubleshooting a software installation problem means you may have to look around in the registry. Getting to know the registry is the subject of this month's column.

## The Registry Structure

In your Windows folders are a couple of huge files named SYSTEM.DAT and USER.DAT. The registry is just a way to organize and easily access the data in those two files.

SYSTEM.DAT contains settings that are specific to the PC hardware regardless of who is using it, while USER.DAT contains settings specific to a user regardless of the PC hardware. This distinction is because

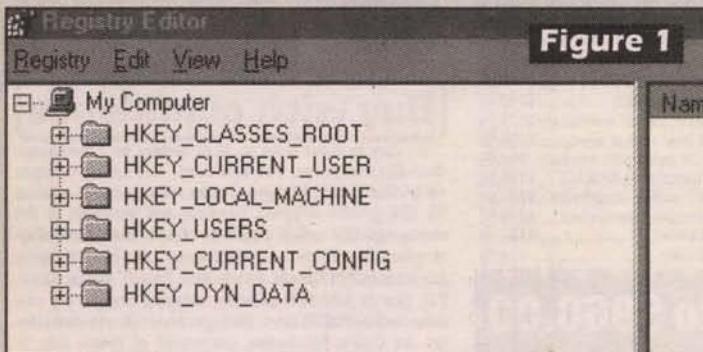


Figure 1

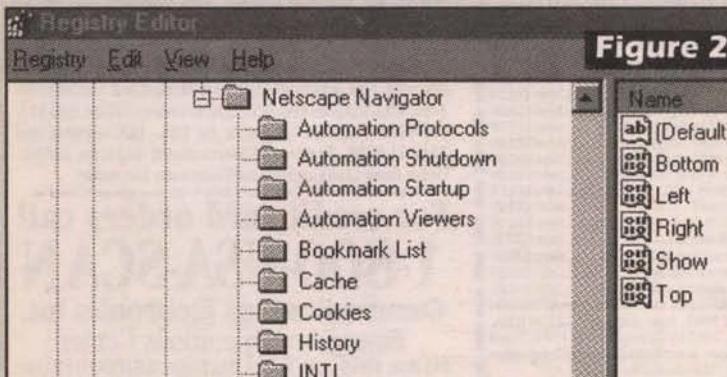


Figure 2

Windows NT and Windows95 were designed to be used in a networked environment. In a network, different users might use different PCs on a network, but might prefer to have the settings (like desktop color) available to them that they use on their "normal" PC. The registry's organization is designed to facilitate such "roving" users.

The registry uses the terms "keys" and "values" to refer to its entries. These are actually new names for concepts you're already familiar with. A key is actually a directory, and a value is just a file. The hierarchical relationships between keys and values is just like the one between directories and files.

Because of the potential for an inexperienced user to cause real problems to their PC, Microsoft went out of their way to make the registry hard to access. To view the registry, you need to go into the Windows folder and double-click the regedit.exe file. When you do, you see something similar to Figure 1. This is called the Registry Editor.

There are six top-level keys in the Windows95 registry. Here is what you'll find in each:

- HKEY\_CLASSES\_ROOT: This is similar to the REG.DAT file found in Windows 3.1 and contains data about object linking and embedding (OLE) servers and containers. This is also where data for "shortcuts" on the Windows95 desktop is found.

- HKEY\_CURRENT\_USER: If the PC is part of a network, this is where the settings and preferences for the user currently "logged on" at this PC are found.

- HKEY\_LOCAL\_MACHINE: This key stores configuration data for all of the hardware that was ever installed on the PC. For example, if you remove your old 28.8K modem and install a new 56K modem, this key will still store the configuration data for the 28.8 modem. In other words, if it was ever installed on your PC, you'll find the configuration data for it here!

- HKEY\_USERS: If a PC is part of a network, this key stores settings and preferences for all users that have ever logged on to the network from the PC. When a user logs on to the network from the PC, his or her data is transferred from this key to HKEY\_CURRENT\_USER.

- HKEY\_CURRENT\_CONFIG: This key stores configuration data for the hardware currently installed on the PC. If you haven't changed any of the hardware on your PC, then this key and HKEY\_LOCAL\_MACHINE should be identical.

- HKEY\_DYN\_DATA: This key is created dynamically when the PC is in use and stores data about the performance of system hardware.

Each of these top-level keys contains sub-keys and values.

## Viewing And Editing A Registry Entry

Figure 2 shows what you see when you

# Understanding The Windows Registry

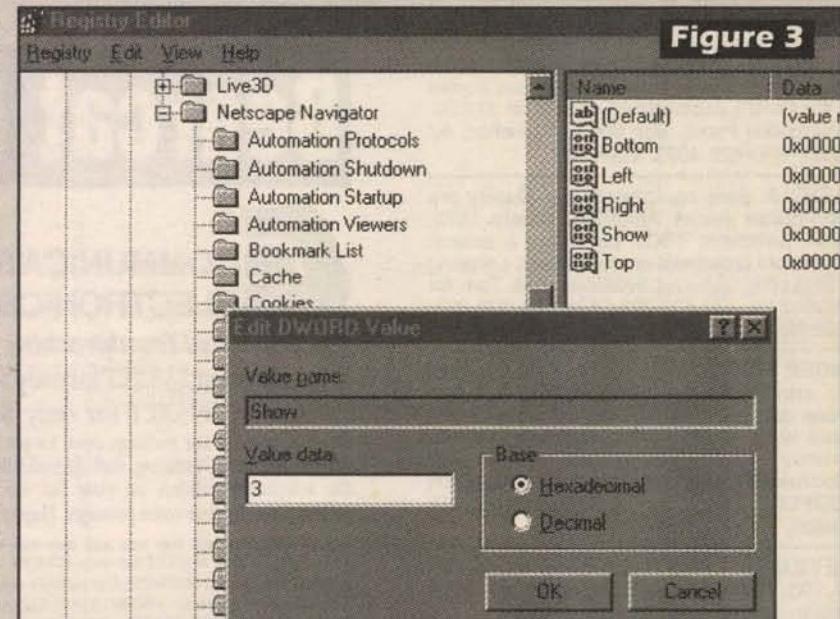


Figure 3

view entries in the Registry Editor. At the left is a list of configuration keys for my copy of Netscape, and at the right are values for a particular key. In this case, the values are for the default location of the Netscape window when I launch that application.

Each value in the registry has a name, which programs use when accessing it. In Figure 2, the names shown are bottom, left, right, show, and top. To the right of each name is the corresponding value associated with the name.

To edit a value, double-click on it in the right side of the Registry Editor. In this example, I clicked the Show value. Figure 3 shows what was displayed next.

You're probably wondering what the heck a "DWORD" value is. It is one of the three possible values a registry entry may have: binary, string, and DWORD. A binary value is just a string of bits, and a string value is a sequence of characters. A DWORD value is a binary value four bytes or less in size.

Notice in Figure 3 that the DWORD value can be expressed in either hex or decimal (hex is used by default in the Registry Editor). You can edit the value of "show" by entering the new value in the box provided in the "Edit DWORD Value" dialog box.

The Registry Editor can also be used to add new keys or values to the registry. To do so, right-click on the key that you want to add the new sub-key or value to. When you do, you will see something similar to Figure 4. Once the new sub-key or value is in place, it can be edited like any other registry value.

At this point, something needs to be very strongly emphasized: As a general rule, you should not use the Registry Editor to change values. Instead, change configuration data using the control panel, the set-up programs for an application, or other system tools other than the Registry Editor. The reason for this is because a mistake in changing a registry value can have catastrophic consequences, such as totally disabling an application, function, or even the entire PC. The real value of the Registry Editor lies in being able to quickly view configuration data and back it up, not in being able to change values.

## But Why Are There Still .INI Files?

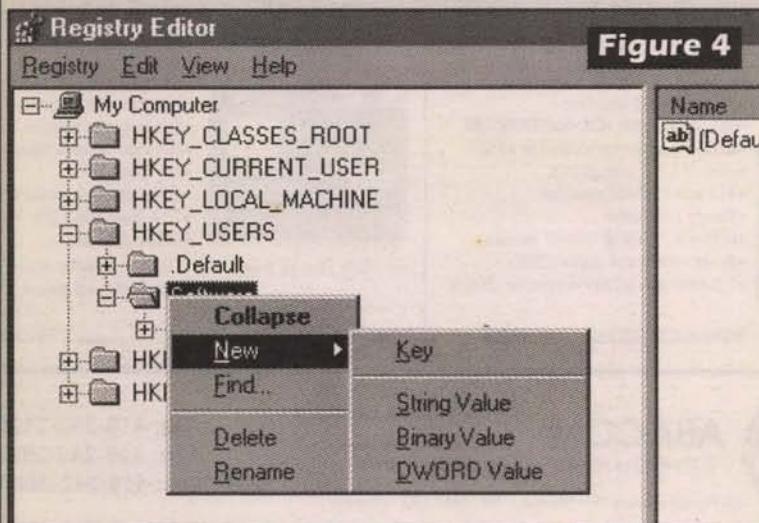
The registry doesn't completely replace .INI files. Each 16-bit Windows application running on your PC will have its own associated .INI files, and SYSTEM.INI and WIN.INI are still there because many 16-bit

# Software Wizardry

applications refer to those files when they load. Basically, the only way to get completely rid of .INI files is to get rid of all 16-bit code on your system!

At some point in the future, the registry is supposed to replace all .INI files in all versions of Windows (even Windows NT still has some .INI files for compatibility with 16-bit software). I have a feeling that .INI files are going to hang around a lot longer than Microsoft says or wants them to!

By the way, the Windows95 registry is not the same as the Windows NT registry. The big difference is that the Windows NT registry does not have a HKEY\_DYN\_DATA key since Windows NT does not yet support the "Plug and Play" configuration technology used by Windows95. Future versions of Windows NT will support Plug and Play, so the two registry versions should become identical.



## When Disaster Strikes!

Since the registry stores all configuration data for a Windows PC, it is a major disaster if it is lost or corrupted in any way. The best way to handle such an event is to be ready for it.

The Add/Remove Programs icon in the Windows95 control panel lets you make an emergency start-up disk. You should always have a start-up disk handy, but unfortunately this disk will not have registry recovery data unless you manually add it. Thus, create a subdirectory on your start-up disk called "Registry Data" (or similar) and copy such files as SYSTEM.DAT, USER.DAT, WIN.INI, SYSTEM.INI, CONFIG.SYS, AUTOEXEC.BAT, and any device drivers into it.

Windows95 does provide a useful, but poorly documented, registry recovery aid. Each time Windows95 boots, it makes a new copy of the registry. The old versions on the hard drive are renamed SYSTEM.DA0 and USER.DA0. These files are stored as

system files in the Windows directory.

Figure 5 shows the location of the SYSTEM.DA0 file on my PC. Note that it is located next to the SYSTEM.DAT file and both are the same size. This is because there was no change in the configuration data for my PC from the previous time I had booted it. The files should always be the same size (and otherwise identical) unless you do something like add a new driver or other software since the previous boot.

If your registry is damaged in some way, you can replace the corrupted or missing SYSTEM.DAT and USER.DAT files with the SYSTEM.DA0 and USER.DA0 files using the same copy procedures used to copy any files. If Windows95 itself won't load, you can use the MS-DOS "copy" command when you boot your PC from the start-up disk.

Despite its complexity and quirks, I think the registry is a real improvement over the scattered .INI files of earlier versions of Windows. Backing up and restoring two files named SYSTEM.DAT and USER.DAT is a lot easier than doing the same with dozens of files! NV

Name	Size	Type
SS	115KB	Bitmap Image
Startup	5KB	Microsoft Program Gr...
Stitches	5KB	Bitmap Image
Straw Mat	1KB	Bitmap Image
Support	6KB	Text Document
Sysmon	64KB	Application
System---	2KB	-- File
System.bak	1KB	BAK File
System.cb	1KB	CB File
System.da0	3,717KB	DA0 File
System	3,717KB	DAT File

Figure 5



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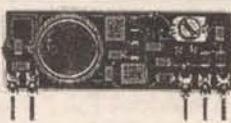
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Panasonic I45	\$72	65	60
Refurb. Panasonic I45	57	55	52
Panasonic I100	52	49	--
Panasonic I75	---	CALL!	---
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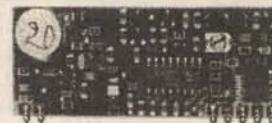
## RF Data Modules



### Transmitters

- Only 30 x 10 x 5mm
- ERP 0.25mW into 50Ω
- 3V(F), 5V(F) or 6-12V(A)
- Up to 20k bps data transfer
- 418 or 433.9MHz FM
- Simple to integrate -
- simply add antenna, data, power
- Range up to 200m
- Analog or digital data i/p
- SAW controlled - stability
- Wide supply range 4.5-9V (A/F ver.)
- Fast enable time <3ms

TXM-4XX-A..... \$24.50  
TXM-4XX-F..... \$25.80



### Receivers

- Only 21 x 47 x 5mm
- 13mA; 130uA on power save (100:1)
- Carrier detect o/p
- Simple to integrate
- Up to 20k bps
- 418 or 433.9MHz FM Superhet
- SAW controlled - stability
- Analog or digital data o/p
- Wide supply range 4.5-9V (A/F ver.)
- Fast enable time <3ms

SILRX-4XX-A..... \$39.38  
SILRX-4XX-F..... \$41.92

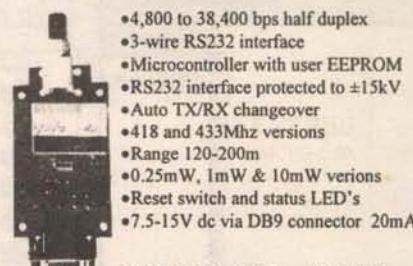


### Transceivers

- Only 23 x 33 x 11mm
- Up to 40,000bps of balanced code
- 19200 baud with ASCII
- Up to 170m range
- 5v operation
- 0.25mW into 1/4 wave antenna
- 418 or 433MHz FM
- Fast 1ms enable for power saving
- Direct interface to 5V CMOS logic
- Auto TX/RX changeover

BIM-4XX-F..... \$87.36

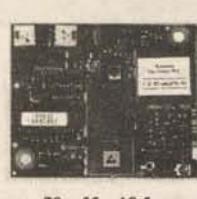
### RS232 Transceivers



- 4,800 to 38,400 bps half duplex
- 3-wire RS232 interface
- Microcontroller with user EEPROM
- RS232 interface protected to ±15kV
- Auto TX/RX changeover
- 418 and 433MHz versions
- Range 120-200m
- 0.25mW, 1mW & 10mW versions
- Reset switch and status LED's
- 7.5-15V dc via DB9 connector 20mA

BIM-4XX-RS232 .... \$139.30

### Synthesized Transceivers



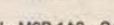
- 64 channels, 25kHz width
- 464.075-464.850MHz
- Integral loop antenna
- External antenna option
- 5V operation
- 600m range -internal ant.
- TTL logic level I/O
- 5kbps data rate
- 10μA in standby mode
- 10mW RF o/p power

TXR-464-DTR100 ..... \$313.50



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**PICS, GALS READ** if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.

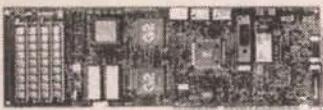
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**97C042** \$19.95

#### 16-BIT MFM HARD DRIVE CONTROLLER

DTC P/N 5280.

**97C045** \$4.95 each

#### DB-9 GENDER CHANGER

Male to Male.

**97C046** \$1.98 each



#### RS-232 SURGE PROTECTOR

DB-25 M-F with built-in surge protection. Protects your computer from lightning strikes on your RS-232 devices, and vice versa.

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**97T003** \$5.95 each

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**92P088** 5 Lbs. for \$5.00



#### TV AUDIO DEMODULATOR

Unused unit from cable TV box takes channel 3, 4 or 5 signal and demodulates the audio. Comes with documentation and schematics, plus additional schematics to build add-on video demodulator board.

**92A028** \$9.95 each



#### LAPTOP/PALMTOP COMPUTER CARRY CASE

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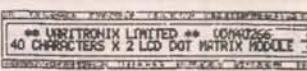
**15-7056** \$38.00 each



#### UHF TV TUNER

450-980MHz, 70MHz IF out, 0-20V tuning voltage. V<sub>cc</sub>=12V. With docs.

**97V014** \$9.95 each



#### 2x40 CHARACTER LCD DISPLAY

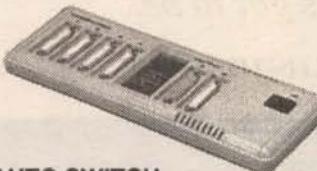
Has 14-pin interface with documentation to help you interface to your microcontroller projects.

**94L005** \$14.95 each

#### 14-DAY PRO-GRAMMABLE TIMER

Originally used to control a satellite receiver through its IR port. Time on/off for eight distinct events. Modify it for your needs or dismantle it for its parts. Programmable with a 2732 EPROM in a removable "personality" module, the unit may be modified to control any IR device through its IR port. Contains Z80 CPU, clock display and associated parts. Operates from 9VDC 500 mA wall transformer which is included.

**92V014** \$9.95 each

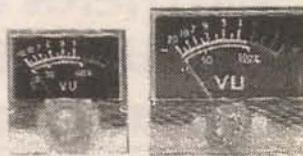


#### 4-to-2 AUTO SWITCH

Input: 4 serial ports. Output: 1 parallel port and 1 serial port. Soft code-controlled printer port selection. Dip switch settings for end-of file time-out (8 or 30 seconds), form-feed enable/disable, and default output port selection. Autoscanning input port arbitration. Concurrent printer port operations.

**13-AS402S** \$70.00 each

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#### VU METERS

250  $\mu$ A at full scale. Meter resistance 1000 Ohms. Black face with VU scale in white and red, marked from -20 to +3.

• 1.625" sq. x 1.125" deep.

**95U011** \$2.00 each

• 1.75" sq. x 1.25" deep.

**95U012** \$2.50 each



#### MAGIC LIGHT

#### LONGWAVE ULTRAVIOLET LAMP

This pocket-sized longwave ultraviolet light may be used for detecting invisible inks, minerals in rocks, etc. It's the size of a pocket pager and even has a belt clip to keep it handy. Runs on two "AA" batteries (not included). 3.25" W x 1.75" H x 1" D.

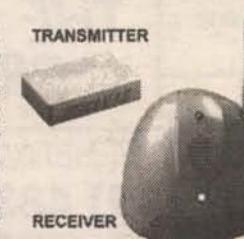
**95L007** \$7.95 each



#### POWER SUPPLY MODULE

AC in: 29V peak, 18V-20V nominal @ 5A. DC in: 25.5V max. DC out: 9V-15V (adjustable), 5A max. Has built-in current-orthermal-limiting overvoltage protection. Lambda #LSS7002A, with docs.

**97E023** \$4.95 each



#### SIGNALMAIL™

This transmitter/receiver pair is designed to alert you when your mail comes. The transmitter is activated by a tilt switch and broadcasts a coded tone that turns on a light and plays a tune in the receiver. These units have dozens of other uses such as perimeter or driveway alarms, gate warning, game trails, etc. The internal tilt switch is easily bypassed for remote switching. Documentation included.

**95Z012** \$14.95/Set



#### 13.8 VDC 6A POWER SUPPLY

Input voltage: 105-125 VAC 60 Hz. Output voltage: 13.8 VDC. New!

**96E004**

\$44.00



#### NIFTY LITTLE BOX

Two-piece, textured-finish, black plastic box, 3.25" x 4.625" x 1.5".

**97U016**

\$2.95 each



#### SIX-WIRE UNIPOLAR STEPPER MOTOR

5.1V @ 1A, 1.8°/step. Shaft 1.4" x 1". Eastern Air Devices #LA23ECK-73.

**97M019**

\$14.95 each

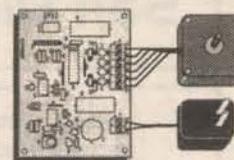


#### MINI GEARMOTOR

12VDC @ 100mA, approx. 75RPM. Size 1.5" L x 0.625"; 0.125" dia. x 0.375" L shaft.

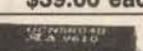
**97M022**

\$9.95 each



#### STEPPER MOTOR DRIVER KIT

Drives unipolar motors from 5V to 30V. Controls speed, direction and step size. Four speed ranges plus single step. Logic output. 97K004



#### UNIPOLAR STEPPER MOTOR DRIVER IC

UCN5804. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 timer, parallel port, etc. Build your own robot, anything that requires precision positioning.

**93I002**

\$4.50 each



#### NIPPON PULSE MOTOR

7.5 deg./step, 48 s/rev, 5 V, stepper with brass gear mounted on shaft. NPM P/N PF42-48ES. With spec sheet. 92M010

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#### COMBO PACK!

One 93I002 IC and 92M010 motor (both shown above) with schematics.

**93I003**

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*at the*  
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*at the*  
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**Sunday**

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# Events

NOVEMBER 1997

NOVEMBER 1

**CA - SANTEE** - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052  
**CT - WATERFORD** - ARC Auction, Senior Citizens Center, Waterford Municipal Complex. Bob KA1BB 860-739-8016

**FL - SORRENTO** - ARRL Hamfest. Chuck Crittenton KE4EXM, 352-669-2075

**MI - LIVONIA** - Super Computer Sale. Livonia Elks Lodge Hall. 31117 Plymouth Rd. 10am-3pm. Computers And You 313-283-1754

**MI - SAULT ST. MARIE** - Hamfest. Lyle Willett K18CE 906-632-0168. E-Mail: lylewill@up.net

**NH - SEABROOK** - Computer Show. Greyhound Park. Northern Computer Shows 508-744-8440

**OH - BROOKPARK** - Hamfest. Dan Sarama KB8A 216-267-5083. E-Mail: kb8a@aol.com

**OK - ENID** - Hamfest. Garfield Co. Fairgrounds, Hoover Bldg. 8am-5pm. Tom Worth N5LWT, 405-233-8473

**PA - YORK** - Computer Show. York Fairgrounds, Old Main Bldg. 10am-3pm. Peter Trapp Shows. 603-272-5008. Web: [www.petertrapp.com](http://www.petertrapp.com)

**RI - WEST WARWICK** - Computer Show. West Warwick Civic Center. MarketPro 201-825-2229

**SC - GREENVILLE** - Computer Show. Palmetto Expo Center. 9:30am-4pm. MarketPro 201-825-2229

**WI - MILWAUKEE** - Hamfest. Burt Steingraeber N9VBI 414-328-0535. Web: <http://execpc.com/~mrc/friendlyfest.htm>

NOVEMBER 1-2

**GA - LAWRENCEVILLE** - ARRL Hamfest. Randy Bassett KRA4NQ 770-410-3989

**SC - GREENVILLE** - Computer Show. Palmetto Expo Center. MarketPro 201-825-2229

**TX - ODESSA** - Hamfest. Ector Co. Coliseum, Exhibit Bldg. C. 42nd & Andrews Hwy. Sat: 8am-5pm, Sun: 9am-2pm. Robert Jordan N5RKN, 915-335-7980. E-Mail: n5rkn@apex2000.net Web: <http://www.apex2000.net/personal/wd5cwy/main.2.htm>

NOVEMBER 2

**CA - LIVERMORE** - Swapmeet. Las Positas College. Noel Anklam 510-447-3857

**CA - OXNARD** - Computer Show. Community Center. 10am-5pm. MarketPro 415-456-6730

**CA - STOCKTON** - Computer Show. Civic Auditorium. 10am-5pm. MarketPro 415-456-6730

**CT - WATERBURY** - Computer Show. Waterbury Sheraton. MarketPro 201-825-2229

**FL - PALM BEACH GARDENS** - Computer Show & Sale. Palm Beach Gardens Marriott. 4000 RCA Blvd. Narisaam Computer Show 770-663-0983

**MI - FLINT** - Super Computer Sale. Holiday Inn, 5353 Gateway Centre. 10am-4pm. Computers And You 313-283-1754

**NC - ASHEVILLE** - Computer Show. Asheville Civic Center. 9:30am-4pm. MarketPro 201-825-2229

**NY - FISHKILL** - Hamfest. John Jay High School. Ken Akasofu KL7JCQ 914-485-9617. E-Mail: KL7JCQ@iname.com Web: <http://www.mhv.net/~fritzing>

**NY - POUGHKEEPSIE** - ARRL Hamfest. Ken Akasofu KL7JCQ 914-485-9617. E-Mail: KL7JCQ@iname.com

**OH - CANTON** - ARRL Auctionfest '97. Stark Co. Fairgrounds. Jack Cale N8FEB, 330-477-8261

**PA - ALLENTOWN** - Computer Show. Days Inn Conference Center. 10am-3pm. Peter Trapp Shows. 603-272-5008 Web: [www.petertrapp.com](http://www.petertrapp.com)

**WI - KAUKAUNA** - ARRL Hamfest. Chad Pennings N9PRC, 414-759-0799

NOVEMBER 7-8

**IL - SPRINGFIELD** - Super Computer Sale. State Fairgrounds. Blue Star Productions 612-788-1901

**MI - MT. CLEMENS** - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

NOVEMBER 8

**AL - MONTGOMERY** - ARRL State Convention, Hamfest & Computer Show. Garrett Coliseum, South AL State Fairgrounds. 8am-5pm. Phil 334-272-7980 after 5pm. E-Mail: prolan@juno.com

**AZ - YUMA** - Hamfest. Harvey Kutterhagen N7WAQ. E-Mail: n7waq@juno.com

**CA - FONTANA** - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

**CA - FRESNO** - Computer Show. Fresno Fairgrounds. 10am-5pm. MarketPro 415-456-6730

**CA - OAKLAND** - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 Web: <http://www.robertaustin.com>

**FL - PORT ST. LUCIE** - ARRL Hamfest. Frank Herring, Sr. N4FBX, 561-336-7169

**IN - INDIANAPOLIS** - AGI Computer Fair.

# CALENDAR

The Events Calendar is a free service limited to electronic events such as computer shows, hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days prior to the event. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:

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**Events Calendar**

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Corona, CA 91719

**Phone** 909-371-8497

**Fax** 909-371-3052

**E-mail** [events@nutsvolts.com](mailto:events@nutsvolts.com)

Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827

**LA - WEST MONROE** - Hamfest. West Monroe Convention Center, corner North 7th & Ridge Ave. 8am-3:30pm. 318-323-6621. E-Mail: [tchc@america.net](mailto:tchc@america.net)

**MI - TAYLOR** - Super Computer Sale. Democratic Club Hall. 23400 Wick Rd. 10am-3pm. Computers And You 313-283-1754

**NH - SALEM** - Computer Show. Rockingham Park Race Track. Northern Computer Shows 508-744-8440. E-Mail: [tchc@america.net](mailto:tchc@america.net)

**NY - POUGHKEEPSIE** - Computer Show. Mid-Hudson Civic Center. MarketPro 201-825-2229

**SC - MYRTLE BEACH** - Radio and Computer Show. Myrtle Beach High School, 38th Avenue North. 9am-5pm Robert Battle 803-236-2887 [www.qsl.net/kf4hav/hamfest.htm](http://www.qsl.net/kf4hav/hamfest.htm)

**NOVEMBER 8-9**

**CA - SACRAMENTO** - Computer Show. Cal Expo. 10am-5pm. MarketPro 415-456-6730

**GA - KENNESAW** - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827

**MO - ST. CHARLES** - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066. E-Mail: [computershows.chicago@mci.com](mailto:computershows.chicago@mci.com)

**NC - RALEIGH** - Computer Show. Embassy Suites Hotel. MarketPro 201-825-2229

**NY - SYRACUSE** - Computer Show. NY State Fairgrounds, Int'l Bldg. Sat: 10am-5pm Sun: 10am-3pm. Peter Trapp Shows. 603-272-5008 Web: [www.petertrapp.com](http://www.petertrapp.com)

**TX - AUSTIN** - Computer Blast '97. Palmer Auditorium. ComputerFest Productions 888-545-5432 [www.computerblast.com](http://www.computerblast.com)

NOVEMBER 9

**CA - SAN DIEGO** - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730

**IL - MACOMB** - ARRL Hamfest. Kathy Page N9KP, 309-426-2723

**IN - ANDERSON** - AGI Computer Fair. Ramada Inn, 5901 Scatterfield Rd. 10am-3pm. 317-299-8827

**KY - LOUISVILLE** - Computer Fair South. Executive West Hotel. 9:30am-3pm. Sammy L. Hastings 812-333-9300

**MA - SWANSEA** - Computer Show. Venus DeMilo. Northern Computer Shows 508-744-8440

**MI - GRAND RAPIDS** - Super Computer Sale. Crowne Plaza. 5700 28th St., S.E. 10am-4pm Computers And You 313-283-1754

**NY - WHITE PLAINS** - Computer Show. Westchester Co. Ctr. MarketPro 201-825-2229

NOVEMBER 14

**NJ - FAIR LAWN** - Hamfest. Joe Sammartino N2QOJ 201-778-3211. E-Mail: [jas130@juno.com](mailto:jas130@juno.com)

NOVEMBER 14-15-16

**IA - DES MOINES** - Super Computer Sale. State Fairgrounds. Blue Star Productions 612-788-1901

NOVEMBER 15

**CA - BAKERSFIELD** - Computer Show. Kern Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730

**CA - SANTEE** - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

**FL - FT. LAUDERDALE** - Computer Show & Sale. Holiday Inn West. 5100 N. St. Rd. 7. Narisaam Computer Show 770-663-0983

**NY - BUFFALO** - Computer Show. Hamburg Fairgrounds. MarketPro 201-825-2229

**MA - PLYMOUTH** - ARRL Hamfest. Jim Ford NM1F 508-747-2224

**PA - HERSHHEY** - Hamfest. Hershey Armory. Harold

Baer 717-566-8895

NOVEMBER 15-16

**CA - VALLEJO** - Computer Show. Solano Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730

**FL - CORAL GABLES** - Hamfest/Tailgate Swapfest. University of Miami, Coral Gables campus, Physics parking lot. 8am-Noon. Walt 305-895-0398

**IN - FORT WAYNE** - Hamfest & Computer Expo. Allen Co. War Memorial Coliseum and Exposition Center. Sat: 9am-4pm, Sun: 9am-3pm. Doug Jones 219-484-1314. E-Mail: [djones2233@ol.com](mailto:djones2233@ol.com) Web: <http://www.pipeline.com/~dagagnon/>

**MI - DEARBORN** - Super Computer Sale. Dearborn Civic Center, 15801 Michigan Ave. 10am-4pm. Computers And You 313-283-1754

**NC - WINSTON-SALEM** - Computer Show. Lawrence Joel Veterans Memorial. MarketPro 201-825-2229

**OH - CLEVELAND** - Computer Show. I-X Center. Sat: 10am-6pm, Sun: 10am-4pm. Peter Trapp Shows 603-272-5008. Web: [www.petertrapp.com](http://www.petertrapp.com)

NOVEMBER 16

**CA - LANCASTER** - Computer Show. Antelope Valley Frnds. 10am-5pm. MarketPro 415-456-6730

**CA - SAN DIEGO** - Computer Show. San Diego Convention Center. 111 W. Harbor Dr. Paul Martinez 619-295-1221

**FL - WEST PALM BEACH** - Computer Show & Sale. Palm Beach Airport Hilton. 150 Australian Ave. Narisaam Computer Show 770-663-0983

**IL - CHICAGO** - Hamfest. George Sopocko WA9JEZ 773-545-3622

**NC - BENSON** - ARRL Hamfest. Paul Dunn KD4BJD, 919-894-3100

**NH - LEBANON** - Computer Show. Lebanon High School. Northern Computer Shows 508-744-8440

**NJ - FAIRFIELD** - Computer Show. Fairfield Radisson. MarketPro 201-825-2229

**NY - HUNTINGTON** - ARRL Hamfest. Joanne Coletti N2IME 516-399-1877

**NY - ROCHESTER** - Computer Show. The Dome Center. MarketPro 201-825-2229

NOVEMBER 19

**FL - ST. PETERSBURG** - ARRL Hamfest. Don Bice W4PCO, 813-347-2707

**MS - OCEAN SPRINGS** - Hamfest/Swapfest. Latimer Community Center. Fri: 4:30pm-9pm, Sat: 8am-3pm. Harry McLemore KD4AK, 601-872-0732

NOVEMBER 21-22-23

**MI - TAYLOR** - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

NOVEMBER 22

**CA - DALY CITY** - Computer Show. Cow Palace, Gate #5, Geneva & Santos. Robert Austin Corp. 1-800-243-7041, Web: <http://www.robertaustin.com>

**CA - SANTA ROSA** - Computer Show. Sonoma Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730

**MA - NEWTONVILLE** - ARRL Hamfest. Eliot Mayer W1MJ 508-664-0773. E-Mail: [w1mj@amsat.org](mailto:w1mj@amsat.org) Web: <http://ourworld.compuserve.com/homepages/emayer/auction.htm>

**ME - AUGUSTA** - Computer Show. Augusta Civic Center. Northern Computer Shows 508-744-8440

**MI - FLINT** - Super Computer Sale. IMA Arena, 3501 Lapeer Rd. 10am-3pm. Computers And You 313-283-1754

**NY - BINGHAMTON** - Computer Show. The Showplace. Binghamton Plaza. 10am-3pm. Peter Trapp Shows. 603-272-5008. Web: [www.petertrapp.com](http://www.petertrapp.com)

**OH - GEORGETOWN** - ARRL Hamfest. Harold Pryor, 513-378-2824

**SC - CHARLESTON** - Computer Show. King Street

NOVEMBER 22-23

**FL - TAMPA** - Radio & Computer Convention. State Fairgrounds, Expo Hall. Jean 813-525-5178. E-Mail: [kd4phs@earthlink.net](mailto:kd4phs@earthlink.net) (Chris Schwab). Web: <http://www.fgcarc.org>

**NY - LAKE GROVE** - Computer Show. Sports Plus. MarketPro 201-825-2229

NOVEMBER 23

**CA - SACRAMENTO** - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730

**CA - SAN DIEGO** - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730

**IL - WHEATON** - Radio Fest Electronics Flea Market. DuPage Co. Fairgrounds. GMRS 81

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**LIGHTED HEADSET MAGNIFIER \$27.50**

A great new item, this is a hands-free way to see little tiny parts as you work on them without having to be a contortion artist with a soldering iron! The headband style magnifier features bright side lights (4 AAA batteries not included) so you can add a little light to the area without clutching a flashlight under your chin! The velcro adjustable headband fits comfortably around your head, and the "goggles" pull down over your eyes for easy visibility. The visor has a built-in 1.8X lens plus a flip-down magnifier lens and a pull-down loupe for extra magnification power up to 4.8 times!



**VIRTUAL REALITY COLOR VIDEO HEADSET WITH AUDIO AND MOTION SENSOR \$65.00**

**Watch late night TV without disturbing anyone!** This video viewing system can be connected to your VCR and you can watch (and hear) your program on the headset! Of course, it is not like the picture on that 12 foot big screen at the local sports pub, but you can watch in your jammies and see who the guests are on your favorite late night talk show!

**Play your favorite video games arcade style!**

Designed for use with many Super NES and Sega Genesis games, the headset has both audio and motion sensing capabilities. Generally speaking, this is ideal for racing, flight, and tank simulators with a first person or rear view perspective, and games with an eye level perspective.

System features volume control, sensitivity control, brightness control, tint control, as well as a reset button and mode switches to select your application. Composite video headset system includes headset, tracking tube (for motion sensing), AC adapter, Super NES cable assembly and Sega Genesis cable assembly. A pinout is also included for TV/VCR viewing.



The peltier junction is a solid-state thermovoltaic device. Current applied to the device will produce heat on one side of the device and a cold surface on the other side. Water placed on the surface will freeze or boil depending on polarity of applied voltage. Ideal for applications from 3-12 VDC -- grab a battery and let your imagination run wild! DOCUMENTATION INCLUDED!!!

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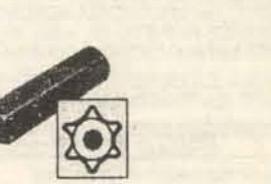


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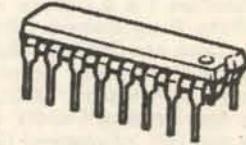
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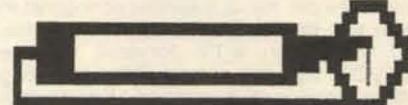


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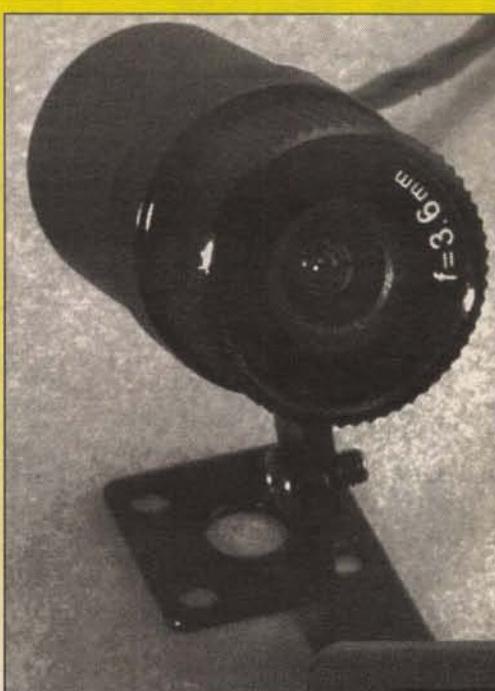
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Nuts & Volts Magazine/November 1997 51



# USER'S GUIDE TO AUDIO POWER AMPLIFIER ICs

Part 4

by Ray Marston

The first three episodes of this five-part series explained various audio power amplifier IC operating principles and presented a selection of practical application circuits based on popular audio power amplifier ICs with maximum output power ratings in the range of 325mW to 12W.

This month's episode continues the 'audio power amplifier' theme by looking at ICs with output power ratings ranging from about 18W to 68W.

Device number	Amplifier type	Maximum output power	Supply voltage range	Distortion, into 8R0	Z <sub>H</sub>	A <sub>V</sub>	Bandwidth	Quiescent current
TDA2030	Mono	18W into 4R0	±8 to ±18V	0.1%, Vs = ±18V, Po = 4W	5M0	30dB	150kHz	40mA
TDA2005M	Dual	20W into 2R0	6 to 18V	0.25%, Vs = 14.4V, Po = 16W (2R0)	100k	50dB	40Hz - 20kHz	75mA
TDA2040	Mono	22W into 4R0	±3 to ±20V	0.08%, Vs = ±18V, Po = 10W into 4R0	5M0	30dB	100kHz	30mA
LM1875	Mono	25W into 4R0	20 to 80V	0.015%, Vs = 50V, Po = 20W	1M0	28dB	70kHz	70mA
TDA2050	Mono	32W into 4R0	9 to 50V	0.05%, Vs = ±19V, Po = 15W	500k	30dB	20Hz - 20kHz	55mA
TDA1514A	Mono	40W into 4R0	±7.5 to ±30V	0.003%, Vs = ±28V, Po = 32W	1M0	30dB	25kHz	60mA
LM3875	Mono	56W into 8R0	20 to 84V	0.06%, Vs = ±35V, Po = 40W	150k	30dB	80kHz	30mA
LM3876	Mono	56W into 8R0	24 to 84V	0.08%, Vs = ±35V, Po = 40W	150k	30dB	80kHz	30mA
LM3886	Mono	68W into 4R0	20 to 84V	0.03%, Vs = ±28V, Po = 60W (4R0)	150k	30dB	80kHz	50mA

Figure 1. Basic details of the nine ICs with output power ratings in the range of 18W to 68W.

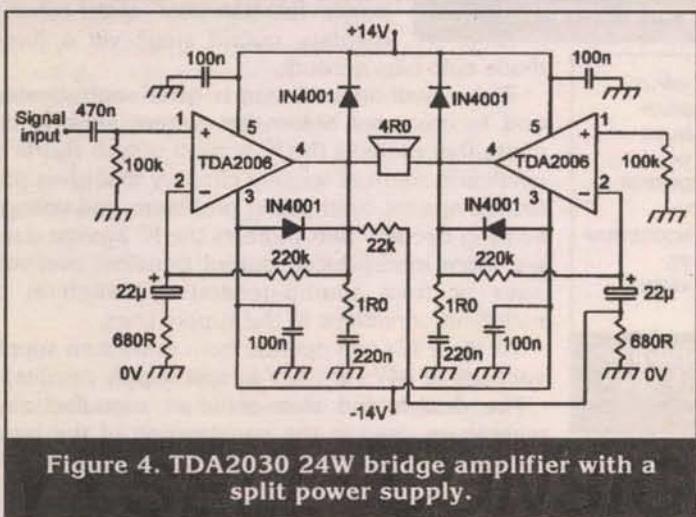


Figure 4. TDA2030 24W bridge amplifier with a split power supply.

## HIGH-POWER (18W to 68W) ICs

Figure 1 gives basic details of the nine IC types that are dealt with in this episode. Note that all but one of these ICs are mono types, that a pair of these mono ICs are thus needed to make a stereo system, and that such an amplifier has a total output power equal to double the per-channel value.

The only 'dual' IC in the list is the TDA2005M, which actually houses a pair of independently accessible power amplifiers that, in most practical applications, are connected in the bridge configuration to provide 20W of drive into a 2R0 mono load in automobile applications. Throughout the remainder of this episode, the nine listed ICs are dealt with in the order in which they appear in Figure 1. Practical

application circuits are given for each IC type but, in some cases, only very brief descriptions are given of individual IC circuit theory.

### THE TDA2030

The TDA2030 is a very popular, high-quality audio amplifier IC that can be regarded as an uprated version of the TDA2006, and is housed in a similar five-pin TO220 package with built-in heat tab, as shown in Figure 2. The IC can operate with single-ended supplies of up to 36V, or with balanced

Ray Marston looks at nine popular audio power amplifier ICs with maximum output power ratings in the range of 18W to 68W in this penultimate episode of this five-part series.

### THE TDA2005M

The TDA2005M is a 20W audio power booster IC specifically designed for use in automobiles, and is fully protected against output short circuits, etc. The IC actually houses a pair of independently accessible power amplifiers that can each pump about 4W into a 4R0 speaker load but, in most practical applications, are connected in the bridge configuration to provide 20W of drive into a 2R0 mono load when the IC is operated from the 14.4V (nominal) power supply of an automobile. The IC is housed in an 11-pin package, as shown in Figure 5. Figure 6 shows a practical applications circuit that can deliver 20W to a 2R0 speaker load; note that all capacitors must be rated at 25V minimum.

### THE TDA2040

The TDA2040 is a high-quality power amplifier IC intended for use in hi-fi applications, and is designed to operate from split power supplies. The device typically generates up to 22W of audio power (at 0.5% THD) in a 4R0 speaker when powered from a split  $\pm 16$ V supply. The IC

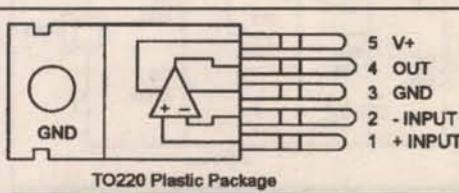


Figure 2. Outline and pin notations of the TDA2030 18W power amplifier.

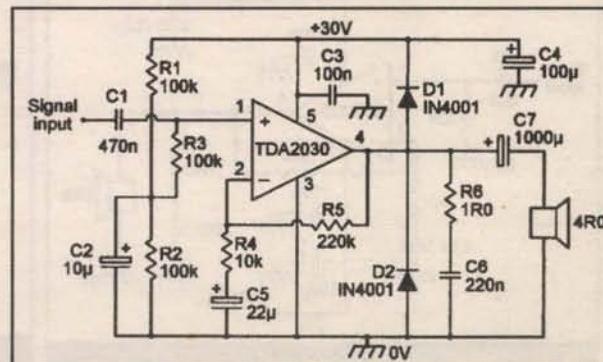


Figure 3. TDA2030 15W amplifier with a single-ended supply.

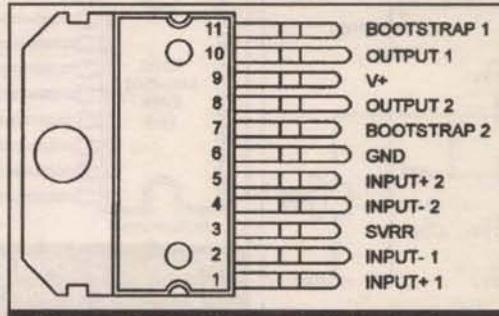


Figure 5. Outline and pin notations of the TDA2005M 20W bridge-connected amplifier IC.

split supplies of up to  $\pm 18$ V, and can deliver up to 18W into a 4R0 load. When used with a +28V single-ended supply, it gives a guaranteed output of 12W into 4R0, or 8W into 8R0. Typical THD is 0.05% at 1kHz at 7W output, rising to less than 0.1% at 8W.

The TDA2030 can be used in the same basic audio amplifier circuits as the TDA2006, but with suitable increases in the circuit supply voltages. Figure 3, for example, shows how to connect the TDA2030 as a 15W amplifier using a single-ended +30V supply and a 4R0 speaker load, and which gives a voltage gain of 30dB.

Alternatively, Figure 4 shows how to wire a pair of TDA2030 ICs as a split-supply bridge amplifier that can deliver 24W into a direct-coupled 4R0 speaker load while generating typical total harmonic distortion of less than 0.5%.

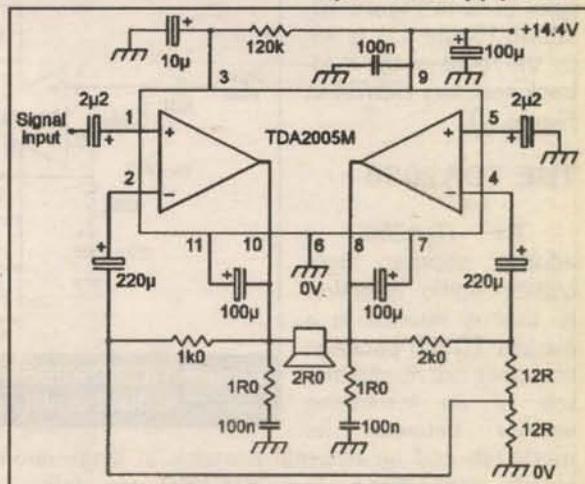


Figure 6. TDA2005M 20W power booster for use in automobiles.

is internally protected against temporary overloads or output short-circuits, and incorporates automatic thermal shutdown circuitry. The IC is housed in a five-pin package designed for vertical mounting on the PCB and has the outline and pin notations shown in Figure 7. Figure 8 shows the IC's basic application circuit as a 22W amplifier powered from split (dual) supplies. With the component values shown, the circuit gives a  $\times 32$  voltage gain and has an input impedance of 22kΩ.

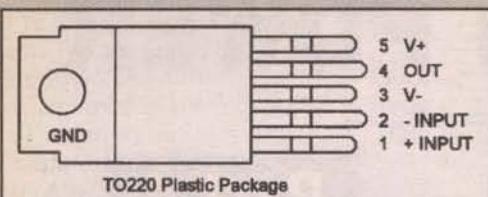


Figure 7. Outline and pin notations of the TDA2040 22W audio IC.

## THE LM1875

The LM1875 is a very popular, very high-quality audio amplifier that can deliver a maximum of 25W into a 4R0 load; it will deliver 20W into a 4R0 load when using a 50V supply and generating a mere 0.015% of THD. The IC is housed in a five-pin TO220 package that does not require the use of an insulating washer between its metal tab and an external heatsink in single-ended supply applications. Note, however, that an insulating washer must be used if the device is powered from dual (split) supplies.

Figure 9 shows the outline and pin notations of the LM1875, which — like most modern audio high-power amplifier ICs — is very easy to use, but requires some care in the design of its PCB. Figures 10 and 11 show practical ways of using the IC in audio application circuits using single and dual power supplies, respectively. Note in both of these circuits that input capacitor C1 is a non-polarized electrolytic type, and that the closed loop voltage gain (x22 in Figure 10, x20 in Figure 11) is set by the ratios of the feedback resistors (R5/R4 in Figure 10).

## THE TDA2050

The TDA2050 is another popular, high-quality audio amplifier IC that is housed in a five-pin TO220 package that does not require the use of an insulating washer between its metal tab and an external heatsink in single-ended supply applications. The TDA2050 can deliver a maximum of 32W into a 4R0 load or 25W into an 8R0 load when powered from a 45V (single ended) supply; when delivering 24W into a 4R0 load, it typically generates a modest 0.03% of THD.

Figure 12 shows the outline and pin notations of the TDA2050, and Figures 13 and 14 show practical audio amplifier application circuits that use single-ended or dual power supplies and can generate up to 32W in a 4R0 speaker load.

The circuits are very similar to those of the LM1875 (see Figures 10 and 11); note in both

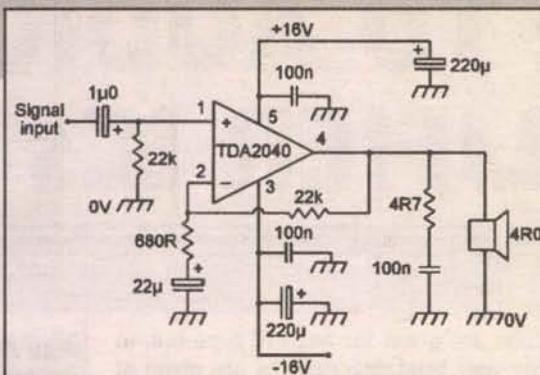


Figure 8. TDA2040 22W audio amplifier using split supplies.

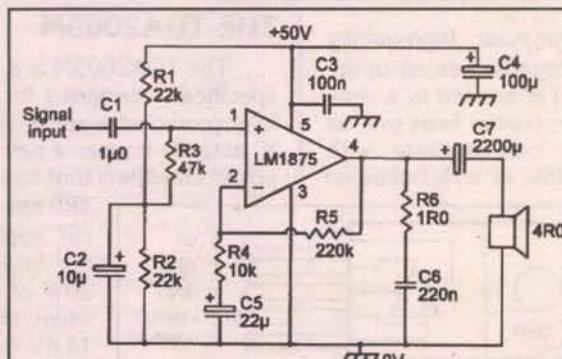


Figure 10. LM1875 20W amplifier using a single-ended power supply.

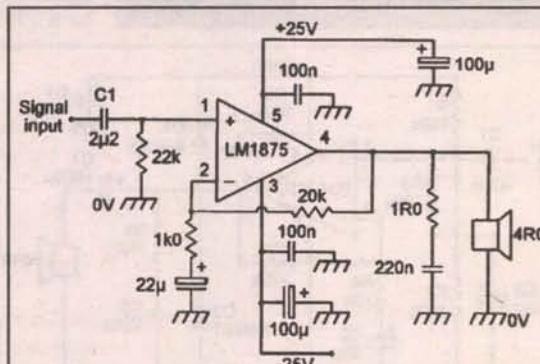


Figure 11. LM1875 20W amplifier using a dual (split) power supply.

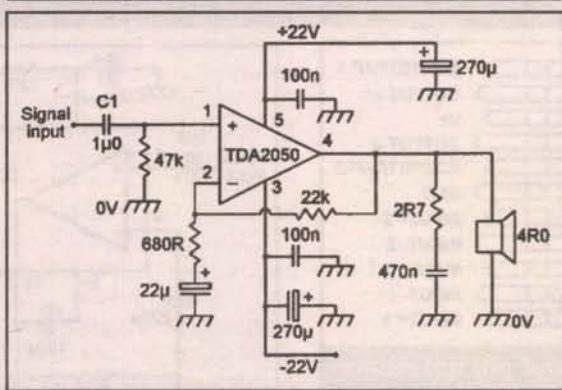


Figure 14. TDA2050 32W amplifier using a dual (split) power supply.

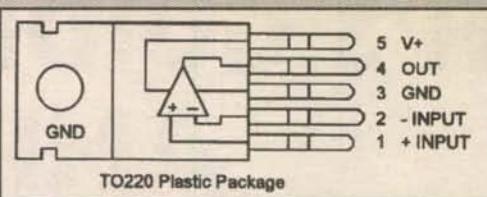


Figure 9. Outline and pin notations of the LM1875 25W amplifier.

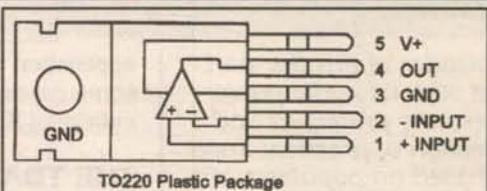


Figure 12. Outline and pin notations of the TDA2050 32W amplifier.

circuits that input capacitor C1 is a non-polarized electrolytic type, that the input impedance is set at about 47K by the input resistor (R3 in Figure 13), and that the closed loop voltage gain is set at x32 by the ratios of the feedback resistors (R5/R4 in Figure 13).

## THE TDA1514A

The TDA1514A is a very

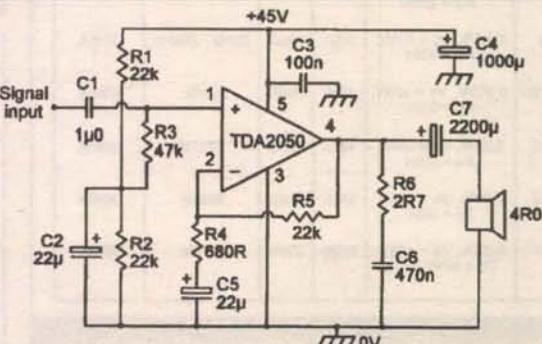


Figure 13. TDA2050 32W amplifier using a single-ended power supply.

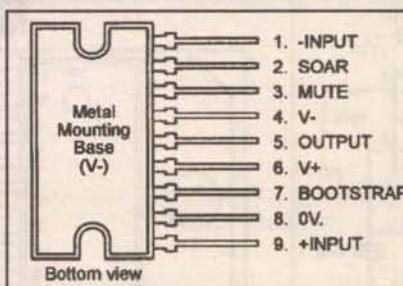


Figure 15. Outline and pin notations of the TDA1514A 40W amplifier.

high-quality, 'super-fi' audio amplifier IC that is designed for use with split power supplies and can deliver a maximum of 40W into a 4R0 load when using a ±21V supply or 40W into an 8R0 load when using a ±27.5V supply; it typically generates a mere 0.0032% of THD when delivering a 32W output. The IC is housed in a nine-pin flat package with an integral heatsink that is internally connected to the IC's negative supply pin (pin 4); the heatsink must be insulated from ground in all split-supply applications.

The IC is quite sophisticated, and incorporates output mute circuitry that eliminates speaker 'thumps' at power switch-on and switch-off, plus other circuitry that prevents damage from output short circuits or overloads, and from thermal runaway problems.

Figure 15 shows the outline and pin notations of the TDA1514A. Note that this is an underside view, seen from the metal mounting base side of the IC.

Also note that the pin 2 'SOAR' title refers to the IC's safe operating area region thermal protection system.

Figure 16 shows a basic application circuit for the IC, as a super-fi audio amplifier that can generate up to 40W in a 4R0 speaker.

This same circuit can be used to generate 40W in an 8R0 load by simply using supply voltages of ±27.5V, or 25W in an 8R0 load by using a ±22V supply. Note in Figure 16 that the circuit's stability is enhanced with the aid of a 220p capacitor wired between input pin 1 and ground, that pin 7 is bootstrapped from the pin 5 output terminal, and that the IC's closed loop voltage gain is set at x32 by the 22K/680R feedback resistors.

In practical versions of this basic design, the circuit's high-frequency performance may be enhanced by shunting all signal-carrying electrolytics with 220n ceramic capacitors.

## LM3875/76/86 BASICS

National Semiconductor produces a range of three super-fi audio amplifier ICs with maximum output power ratings that cover the range of 56W (into 8R0) to 68W (into 4R0).

The three ICs are the LM3875, the LM3876, and the LM3886, and they all use the same basic chip design.

This design consists of a high-impedance differential input stage that has its output direct-coupled to the input of a common-emitter output-driver that uses a constant-current generator as its high-impedance collector load.

This driver transistor drives a high-power five-transistor quasi-complementary output stage via a three-diode auto-bias network.

The overall basic design is quite sophisticated, and incorporates automatic current sensing circuitry that protects the IC against output shorts or overloads, thermal sensing circuitry that gives protection against overheating problems, and voltage-sensing circuitry that protects the IC against damage from load-induced output transient over-voltages or from thump-generating switch-on or switch-off conditions in the supply lines.

All three ICs can operate from maximum supply voltages of 84V (or ±42V in split supply circuits).

The design and state-of-the-art manufacturing techniques used in the construction of the basic

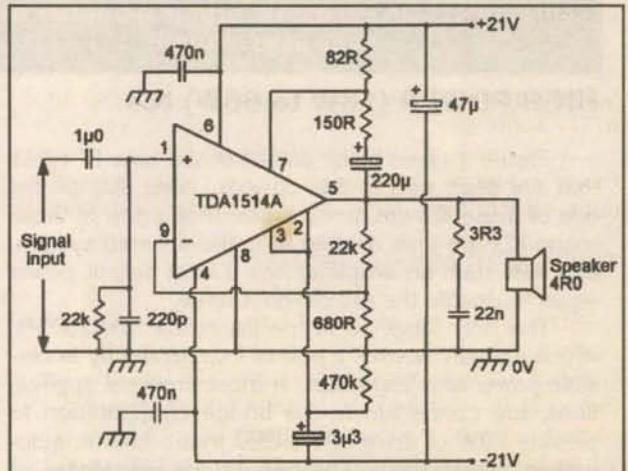


Figure 16. Basic application circuit for the TDA1514A, as a super-fi 40W audio amplifier.

**Next month's concluding episode will describe practical IC-based audio power amplifier circuit design techniques.**

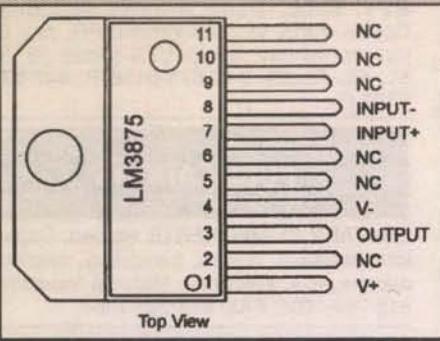


Figure 17. Outline and pin notations of the LM3875 56W amplifier.

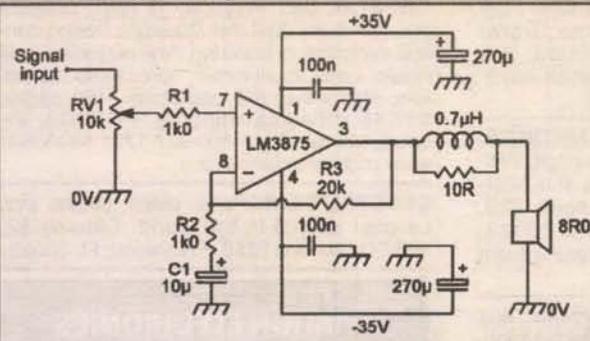


Figure 18. LM3875 56W amplifier using a dual (split) power supply.

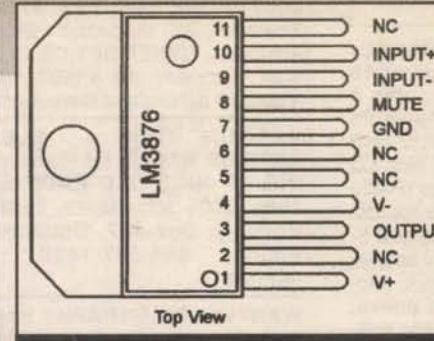


Figure 19. Outline and pin notations of the LM3876 56W amplifier with input muting facility.

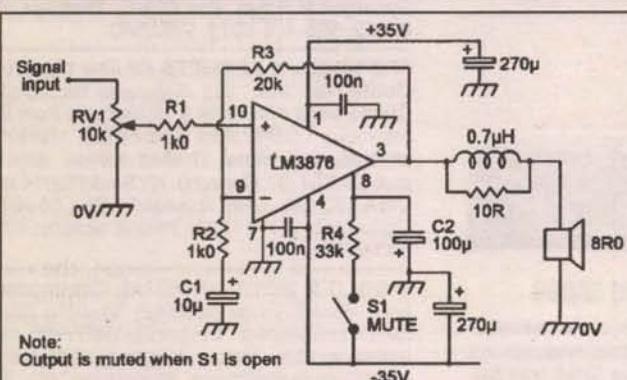


Figure 20. LM3876 56W dual-supply amplifier, with muting facility.

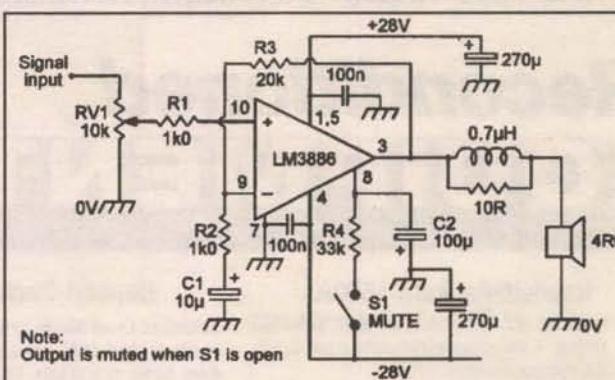


Figure 22. LM3876 68W (into 4R0) dual-supply amplifier, with muting facility.

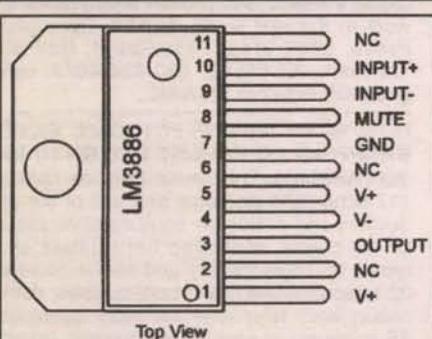


Figure 21. Outline and pin notations of the LM3886 68W amplifier with input muting facility.

such that all three ICs offer exceptionally good operating characteristics. They all have signal-to-noise ratios better than 95dB, have typical power supply rejection ratios of 120dB (enabling the ICs to use unregulated supplies), have typical open-loop gains of 120dB, and have typical gain-bandwidth product values of 8MHz. All three ICs use an 11-pin single-in-line TO-220 plastic package with an integral heat tab, but use their own unique sets of pin notations.

In the standard versions of these ICs (which carry a 'T' suffix at the end of their part number), the heat tab is internally connected to the IC's pin 4 supply-negative terminal, and the IC must thus be bolted to an external heatsink via an insulating washer in dual-supply applications.

Special versions of the ICs are available in packages with electrically isolated heat tabs that can be bolted directly to external heatsinks; these ICs carry a 'TF' suffix.

In all cases, pin 1 of the IC is indicated by a small round indent in the molded package. Brief descriptions, etc., of the three individual ICs are as follows.

## THE LM3875

The LM3875 is the most basic of the three high-power super-fi amplifier ICs. Figure 17 shows the outline and pin notations of this particular device. Note that only five of the IC's 11 pins are internally connected, and the IC thus functions as a five-pin (V+, V-, Input-, Input+, and Output) device that can be regarded as a high-quality high-power op-amp.

Figure 18 shows a practical LM3875 application circuit as an amplifier that — when the IC is bolted to

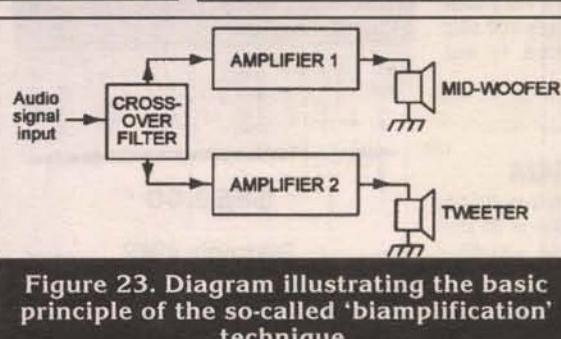


Figure 23. Diagram illustrating the basic principle of the so-called 'biamplication' technique.

semiconductor chips are such that all three ICs offer exceptionally good operating characteristics. They all have signal-to-noise ratios better than 95dB, have typical power supply rejection ratios of 120dB (enabling the ICs to use unregulated supplies), have typical open-loop gains of 120dB, and have typical gain-bandwidth product values of 8MHz. All three ICs use an 11-pin single-in-line TO-220 plastic package with an integral heat tab, but use their own unique sets of pin notations.

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In practical versions of this circuit, the high-frequency stability can sometimes be enhanced by wiring a 220pF capacitor between the IC's inverting and non-inverting input pins.

## THE LM3876

The LM3876 can be regarded as a simple variant of the LM3875, with a highly effective built-in input muting facility. Figure 19 shows the outline and pin notations of this particular device. Note that only seven of the IC's 11 pins are internally connected. The IC can be regarded as a special-purpose, high-quality, high-power op-amp.

Figure 20 shows the practical circuit of an LM3876 mutable amplifier that (when the IC is bolted to an adequate heatsink) can generate up to 56W of audio power into an 8R0 load when the IC is operated from a split ±35V supply.

The Figure 20 circuit is similar to that of Figure 18, with its signal gain set at x20 via feedback components R3/R2, etc., but uses different pin numbering and is provided with a switch-controlled (via S1) muting facility.

The mute circuit actually controls the supply current feed to the IC's internal input and driver stages.

The IC's action is such that the input is fully muted (the IC gives zero audio output) if pin 8 (the MUTE terminal) is open, and only turns on (to give a normal audio output) if a current of 0.5mA or greater flows out of pin 8 towards the circuit's negative supply rail. Thus, in the diagram, the circuit is muted when S1 is open, but gives normal amplifier operation when S1 is closed.

In the mute switching network, R4 controls the muting current, and C2 adds a time constant that smooths out the mute-switching action.

## THE LM3886

The LM3886 can be regarded as a slightly modified and updated version of the LM3876, with the same built-in input muting facility. Figure 21 shows the outline and pin notations of this particular device. Note that eight of this IC's 11 pins are internally connected, with pins 1 and 5 both serving as V+ connecting points. Figure 22 shows a practical LM3886 application circuit as a mutable amplifier that — when the IC is bolted to an adequate heatsink — can generate up to 68W of audio power into a 4R0 load when the IC is operated from a split ±28V supply.

The Figure 22 circuit is very similar to that of Figure 18, with its signal gain set at x20 via feedback components R3/R2, etc., but uses slightly different pin numbering, plus different supply rail and speaker impedance values. If this circuit is used with an 8R0 speaker, it will generate output powers up to 38W when using ±28V supply rails, or up to 50W when using ±35V supply rails.

## BIAMPLIFICATION

The weakest link in most audio power amplifier systems is the loudspeaker. It is almost impossible to design a self-contained loudspeaker that will — at a reasonable cost — linearly span the full audio frequency range.

In most modern hi-fi systems, this problem is overcome by feeding each channel's output to a speaker unit that contains a passive cross-over filter and two (or more) speakers.

One of the speakers (sometimes called a mid-woofer) is designed to efficiently span the low-to-middle frequency range (typically 40Hz to 10KHz), and the other (called a tweeter) to span the mid-to-high frequency range (typically 2KHz to 20KHz).

The cross-over filter feeds the power amplifier's bass signals to the mid-woofer, the treble signals to tweeter, and mid-band signals to both speakers, and is a vital part of this system. The above type of sound distribution system is reasonably efficient at input power levels up to about 25W, but beyond that level, its efficiency falls off significantly due to power losses in the passive filter system.

An increasingly popular solution to this particular problem is — in high-power audio systems — to use the so-called 'biamplication' technique illustrated in Figure 23. This system uses two power amplifiers, with one directly driving the mid-woofer speaker and the other directly driving the tweeter, but with the system's cross-over filter placed ahead of the two amplifiers, where it is used to split audio input signals into two paths. Usually, the filter's cross-over frequency is set somewhere between 500Hz and 1.6KHz.

A major feature of the biamplication system is that its available output power is approximately double that of a single amplifier. Thus, pairs of the various power amplifier IC circuits shown in this episode can — when they are used in the biamplication mode — be used to generate very high per-channel output powers (up to a maximum limit of 112W when used with 8R0 speakers). **NV**

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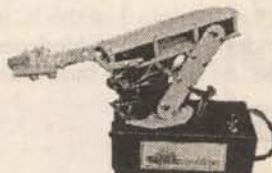
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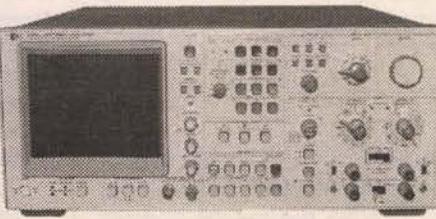
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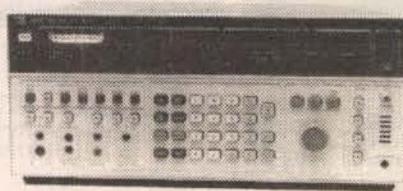
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Guildline 9154C, Transvolt Standard Cell	\$300	Tek 284, Pulse Generator	\$350
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HP 1742A, Scope, 100MHz Dual Trace, DMM	\$400	Tek 475, Scope 200MHz, Dual Trace	\$800
HP 1744A, Scope, Storage, 100MHz, Dual Trace	\$500	Tek 485, Scope 350MHz, Dual Trace	\$750
HP 2804A, Quartz Thermometer, No Probe	\$300	Tek 496P, Programmable Spectrum Analyzer	\$6,000
HP 3320A, Frequency Synthesizer	\$250	Tek 5003, Power Module	\$300
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HP 334A, Distortion Meter	\$300	Tek 7CTIN, Curve Tracer Plug-In	\$350
HP 3406A, Broadband Sampling Voltmeter	\$300	Tek 7D20, Programmable Digitizer PI	\$600
HP 3455A, Digital Multimeter	\$300	Tek 7L13/7603, Spectrum Anayz., 1.1kHz-1.8GHz	\$1,200
HP 3456A, Digital Multimeter, 6.5 Digits	\$800	Tek 7L5, Spectrum Analyzer	\$1,200
HP 3580A, Spectrum Analyzer	\$800	Tek 7S12/S6/S52/S53, TDR Sampler	\$1,200
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HP 5335A, Frequency Counter, 11 Digit, Opt. 010.040	\$800	Tek FG502, Function Generator, 1.1MHz	\$300
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HP 54200A, Digital Storage Scope, Dual Trace, 200MHz	\$1,000	Tek S-53, Trigger Recognizer	\$500
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HP 8640B/02/03, Signal Gen., .5-1024MHz	\$1,800		
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HP 8660C/86603A/86632B, Freq. Syn., 2.6GHz, AM/FM, HPIB	\$2,500		

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# Build a \$15.00 Computer Control Interface for your Scanner

by John R. Montalbano KA2PYJ

**Once you have tried it, you will never want to use that front panel keypad again.**

## Introduction

It did not take long before I got tired of looking up frequencies in my Police Call book and laboriously typing 200 of them into the tiny keypad on the front panel of my new Radio Shack PRO-2032 scanner.

I soon gave up the idea of taking the radio on business trips with me because that meant reprogramming the radio before and after each trip. Furthermore, once the radio was programmed, I would forget what I had put where.

I decided it was time to go where no unauthorized service person is supposed to go and peek under the cover of this baby to see how I could wiggle its channel banks from my PC. The result is this inexpensive computer interface that you can build for almost any modern scanner.

A service manual from Radio Shack revealed two feasible ways to control the radio. The channel set-up information in the PRO-2032 is written and read from a battery backed-up static RAM. I could have hijacked the address and data signals to this device and controlled the writing and reading of channel information from the PC.

I decided against this because it

involved cutting several signal leads in the radio and switching between local and computer control of these signals. Furthermore, the resulting modification and software would have been useful only in this model scanner.

I chose instead to take a more brute force approach so that my computer control interface and software could be used in almost any scanner.

If you hand-wire yours like I did, the hardware cost will be about \$15.00 for the parallel interface version. A serial port version is also described.

The PROgramit software is available from my web page as shareware. The Win3.1/Win95 SW is rather novel in that it provides a simple interface for you to "teach it" how your scanner is programmed and how you have wired the interface to your particular scanner.

Once that is accomplished, you can import frequency databases from popular sources, or create your own manually. You then populate a channel map database by dragging entries from the frequency database to the bank and channel in the channel map where you want that frequency programmed.

You can choose to download to individual channels, entire banks, or the

entire scanner. When you are done, you can disconnect the interface and carry off your programmed scanner.

## Theory of Operation

Like most modern scanners, the PRO-2032 keypad is actually a matrix of switches. The CPU sequentially enables one row of the matrix at a time, and reads back the columns to determine if a key in any row has been pressed (Figure 1). The interface described in this article makes use of a Harris CD74HCT22106 CMOS Matrix switch to parallel each switch in the hardwired keyboard in the scanner.

In the PRO-2032 and most other scanners, this can be accomplished easily and without cutting any traces in the scanner. The switch is programmed to "press" any key on command from your computer. Software on the computer can then perform any sequence of keystrokes to accomplish programming one or more frequencies, or setting the scan limits.

This article describes serial port and parallel port versions of the interface. The parallel port interface is a bit easier to build from scratch and is less

expensive. I found it more desirable to add an inexpensive parallel port to my computer than to try to add a third serial port without causing interrupt conflicts.

The parallel version requires that a 25-pin connector be mounted in some fashion to your scanner. I did not have a problem cutting a rectangular hole in mine, but if you are not that daring, you should consider the serial interface version.

The software was designed to utilize a Standard Parallel Port (SPP). If your computer has its parallel port set for Enhanced Parallel Port (EPP), you may have to change it to SPP.

You can download and run the program diag.exe from the web page to determine if the SW works properly with your computer. The program toggles all of the I/O bits used by the interface at a slow rate so that you can monitor them with a voltmeter, logic probe, or oscilloscope. Further, the current SW for the parallel port version cannot be used on a Windows NT machine.

The serial port version makes use of an EDE300 preprogrammed PIC microcontroller from E-LABs to convert 9600 baud serial data from the PC to the parallel interface of the CMOS switch IC. Only two small mounting holes and a third hole for a round RCA jack need to be drilled in the scanner.

## Construction

The complete schematic for the parallel interface version of the project is shown in Figure 2. The circuit can be built from thru-hole components on a 2-5/8" x 3" piece of perfboard (Figure 3). I chose to mount the DB-25 connector on the PC board and then cut a whole in the chassis through which the connector is mounted.

Be sure not to get any metal filings onto the scanner's circuitry if you go this route. You could also sneak a 25-conductor ribbon cable between the chassis and case to avoid cutting this hole. The board requires five-volt power which was easily obtained from the PRO-2032 power supply.

In some scanners, a small battery powers some of the five-volt power buses even when power is turned off. In that case, you will need to find a five-

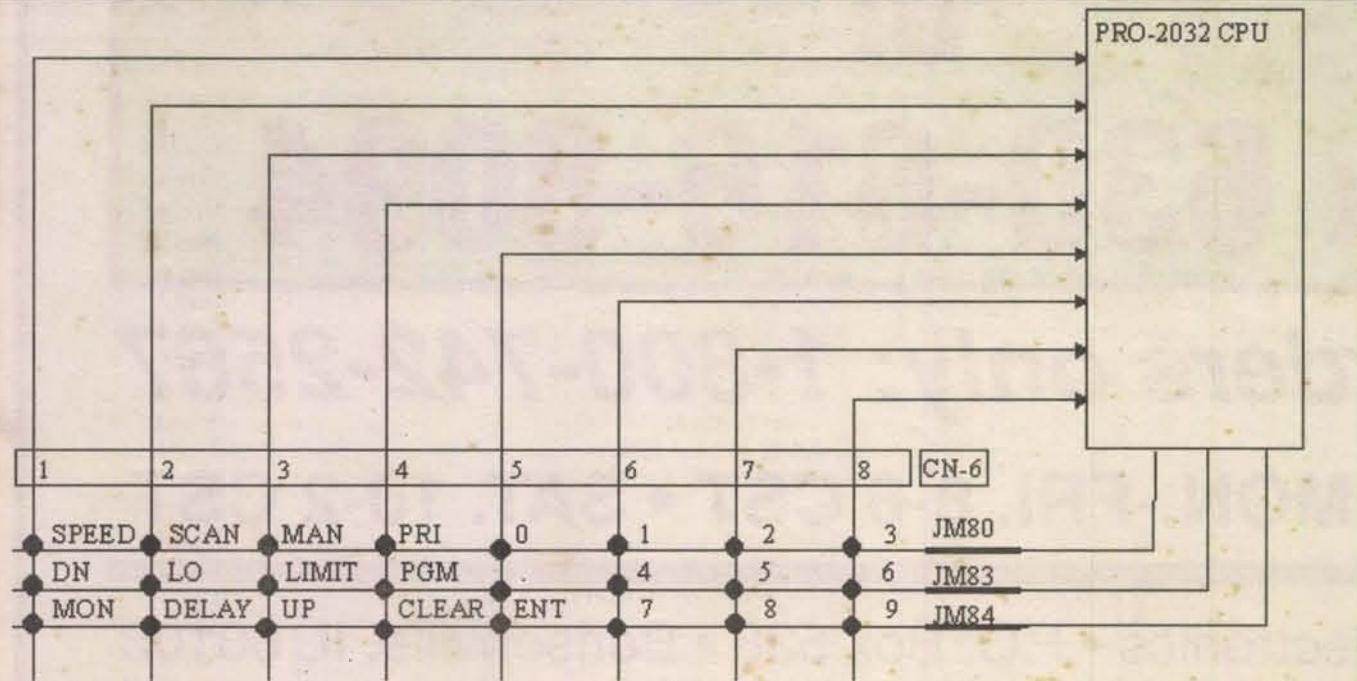


FIGURE 1 — The keypad in the PRO-2032 is scanned by the CPU in a four-row by eight-column matrix. CMOS switches in the PROgramit interface are connected across the intersection of each row and column (e.g., JM80 to CN-6 pin 8 in the PRO-2032 for the "3" key).

volt bus that is switched off completely, or connect the optional on-board five-volt regulator to a switched source of 7.5-14 volts.

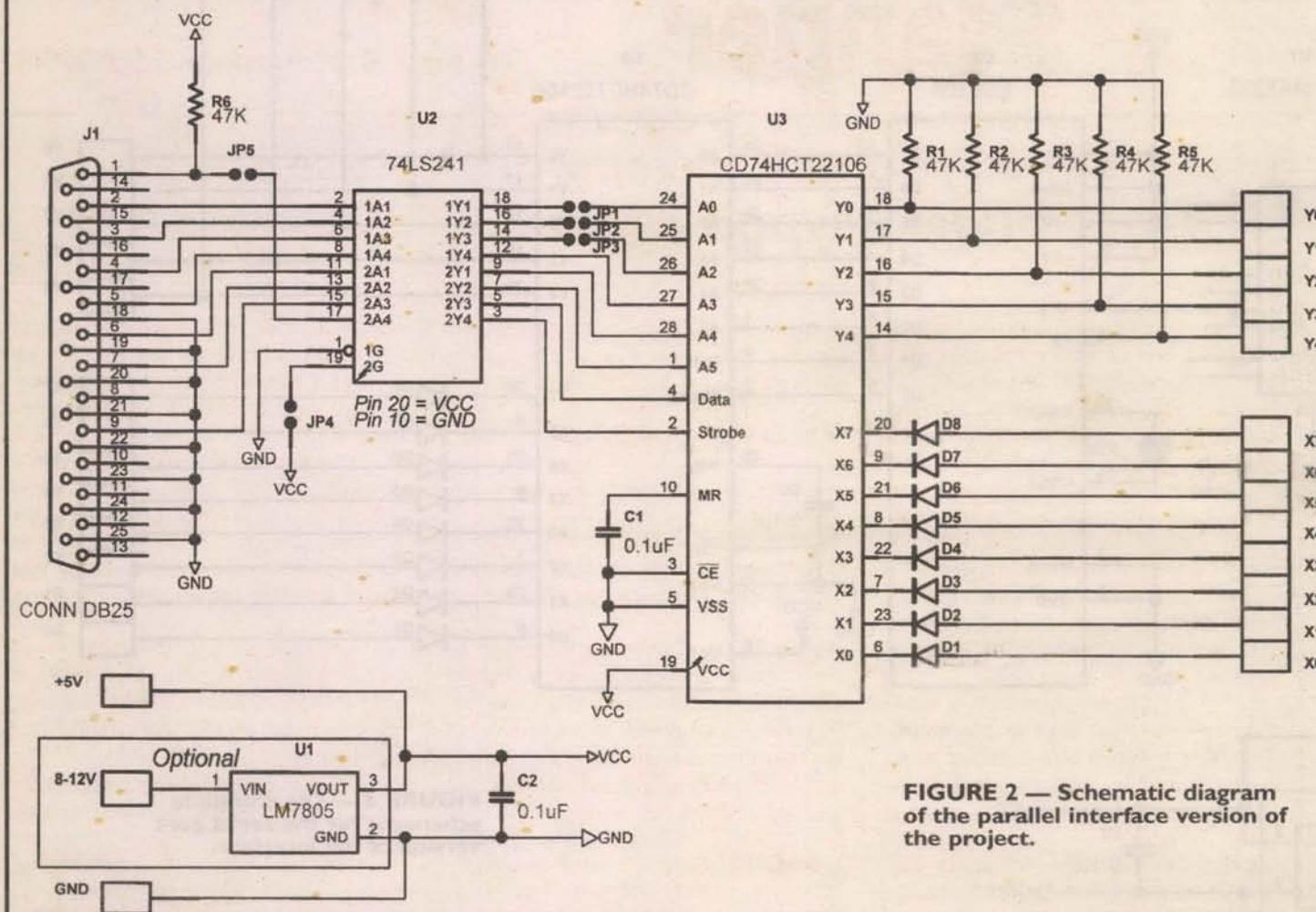
contact the center conductor to ground when inserting or removing the plug with power applied.

## With power app **Installation**

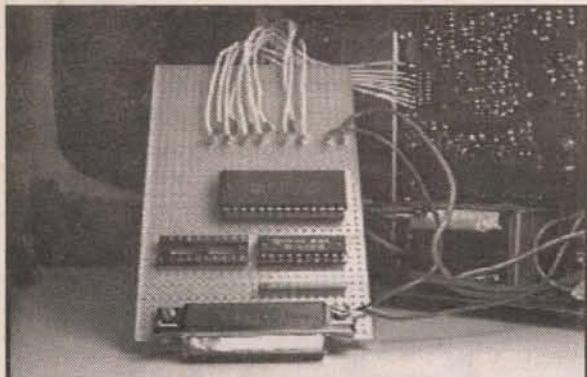
to identify the connections to the rows and columns of the keypad in your scanner from a schematic or by inspection of the scanner's PCB.

figuration from the menu bar. You will be presented with the screen shown in Figure 7.

**Follow these simple steps:**



**FIGURE 2 — Schematic diagram of the parallel interface version of the project.**



**FIGURE 3** — The prototype was hard-wired using #30 gauge wire on a 2-5/8" x 3" piece of perfboard.

The complete schematic for the serial port version is shown in Figure 4. I recommend that you use a female RCA connector for the data connection to the PC since you will be less likely to

those for the PRO2032. I will post instructions for additional models on the PROgramit web page. If yours is not shown, it does not mean that your scanner is not supported. You will simply need

**Sources for the master database include:**

- 1) The FCC web page at <http://www.fcc.gov/wtb/databases.html>
  - 2) Contact Datafiles for information about Probe Software at [datafiles@aol.com](mailto:datafiles@aol.com)
  - 3) Percon Corp.  
4906 Maple Springs/Ellery Rd.  
Bemus Point, NY 14712  
716-386-6013 (24 hrs., 7 days a week)
  - 4) Scanware Associates web page at <http://www.wvsc.wvnet.edu:80/~fcc/>

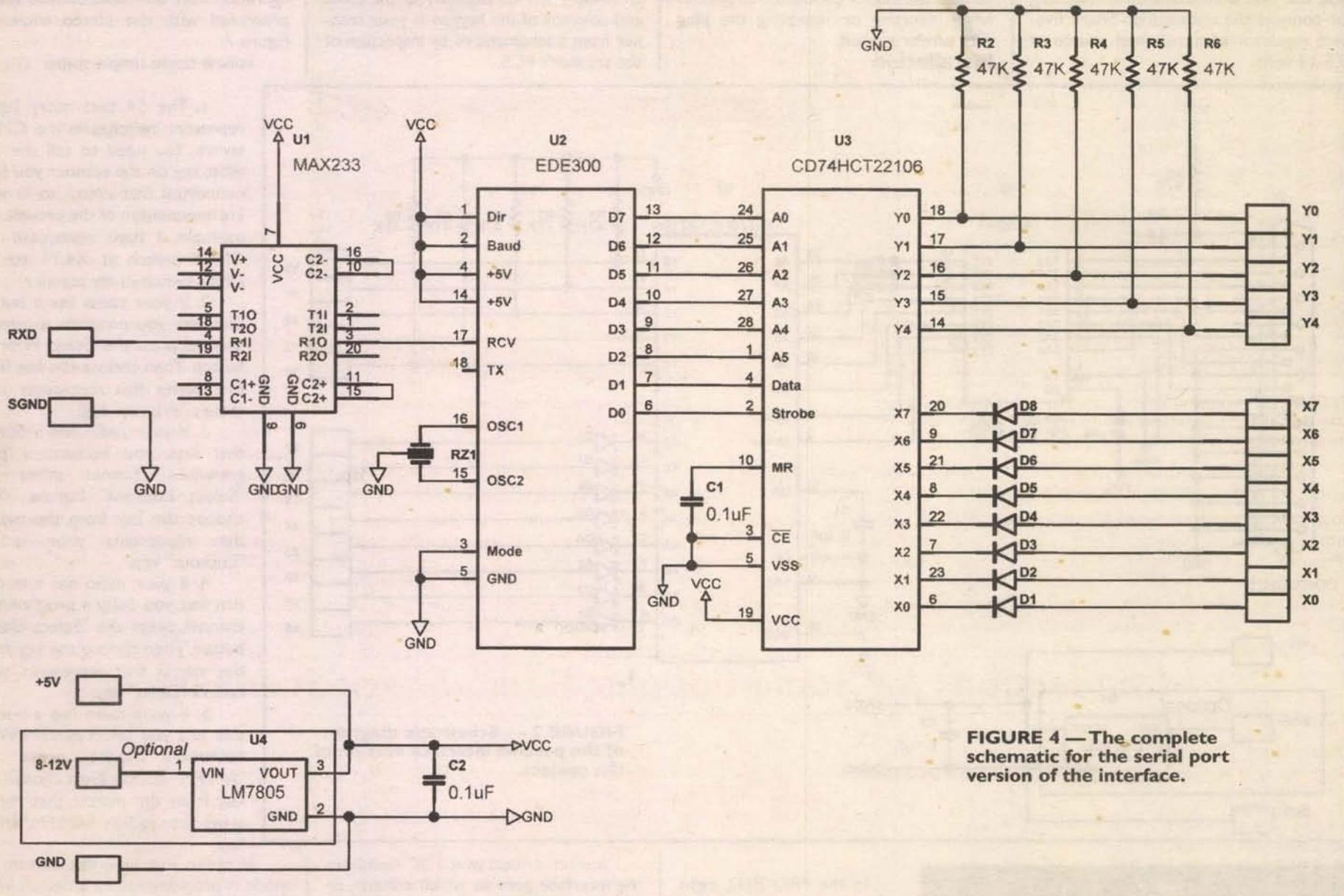
It is not critical which "X" lead from the interface goes to which column, or which Y lead goes to which row. The SW can be configured for the specific connections that you make.

## Software Configuration

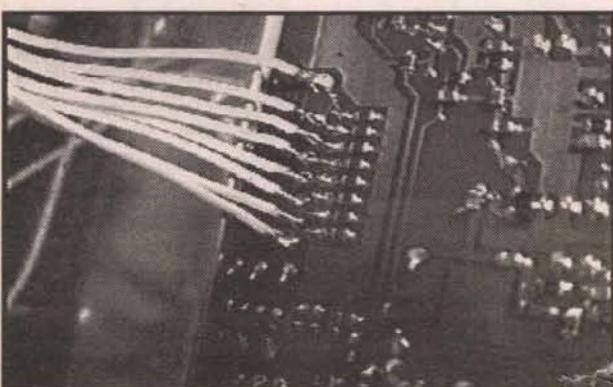
## Select Settings/Hardware Con-

<b>NAME</b>	<b>TYPE/SIZE</b>
Frequency	Text 12
Callsign	Text 10
DBA_Name	Text 40
City	Text 20
County	Text 30
State	Text 24
Latitude	Text 6
Longitude	Text 7
Radio_Stat	Text 4
Class_Stat	Text 4
Priority (Default = False)	Boolean 1
Lockout (Default = False)	Boolean 1
Delay (Default = False)	Boolean 1
Mode (0 = NA, 1 = AM, 2 = NFM, 3 = VFM)	Byte 1
Channel (Not Used)	Integer 2
PLTone (Default = Blank)	Text 5
Spare1 (Default = Blank)	Text 12
Spare 2 (Default = Blank)	Text 12
Spare 3 (Default = False)	Boolean 1
Spare 4 (Default = False)	Boolean 1
Spare 5 (Default = 0)	Double 8
Spare 6 (Default = 0)	Double 8
NumFreq (Frequency String Converted to Double)	Double 8

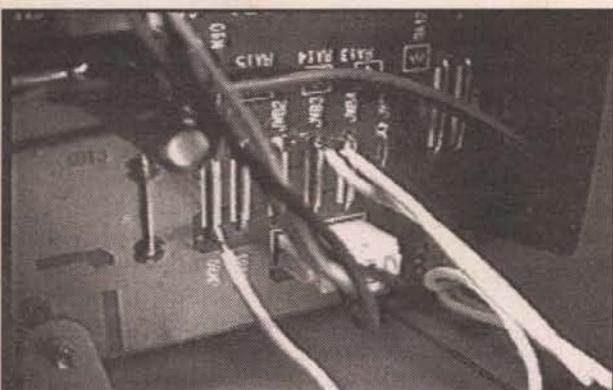
**Table 1- Structure of Frequency Database Tables**



**FIGURE 4 — The complete schematic for the serial port version of the interface.**



**FIGURE 5 — Eight connections are made to CN-6 on the wiring side of the circuit board in the PRO2032.**



**FIGURE 6 — Three connections are made to J80, J83, and J84 on the component side of the circuit board in the PRO2032.**

will be presented with the dialog box shown in Figure 8

Enter the range limits and the corresponding AM/FM/WFM modes for your scanner and press done. The values are stored in a file called ModeDefs.cfg in the install directory. If your scanner does not have an AM/FM/WFM button, be sure to clear the AM/FM text box on the settings screen by clicking on an unlabeled X,Y text box.

1. Enter the total number of channels supported by your radio in the "Number of Channels" text box.

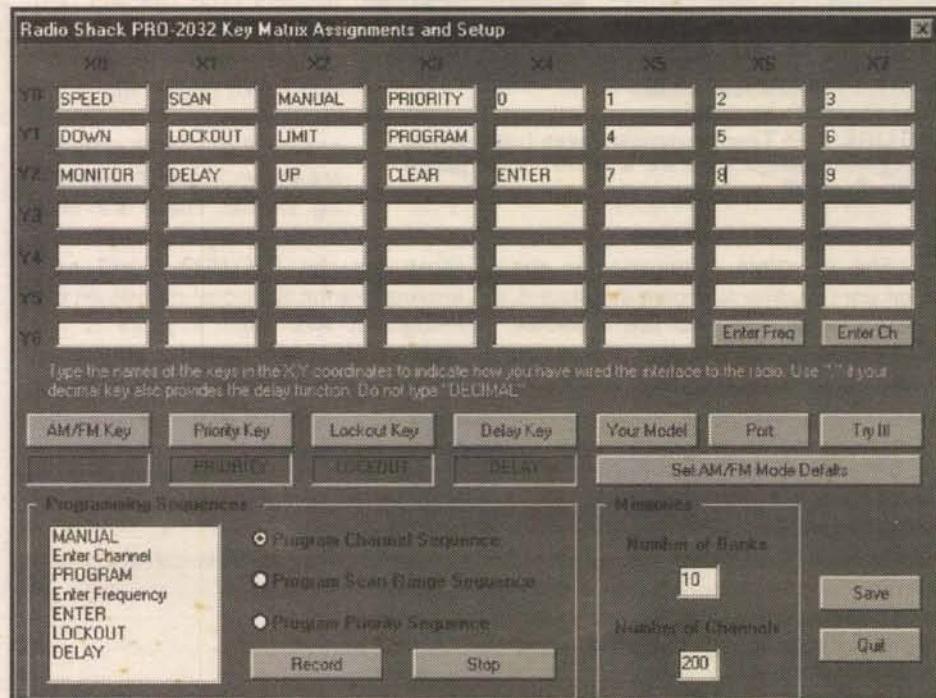
2. Enter the total number of banks supported by your radio in the "Number of Banks" text box.

3. Press the "Your Model" button and enter a character string to identify your model scan-

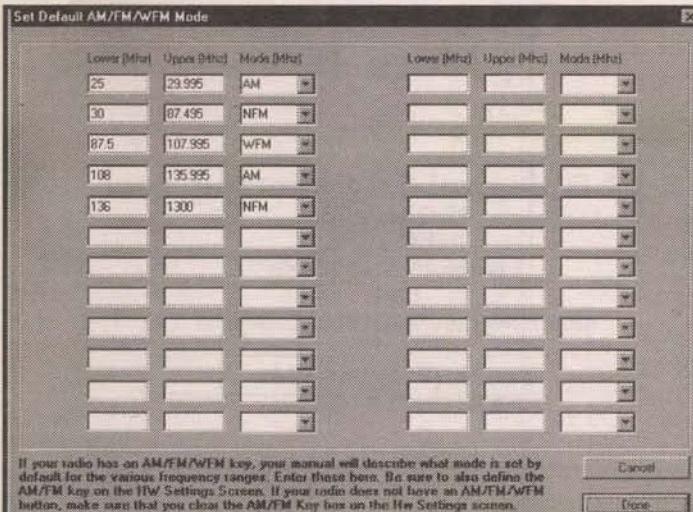
ner. This will be used on the caption bars of some menus.

4. Press the "Port" button and select which port you have connected to the interface. Also set the Delay Factor to an integer number between

3000 and 20000. The delay factor determines how long the interface will "hold down" the buttons on your scanner. You should try to use the smallest number that works reliably with your computer and radio combination.



**FIGURE 7 — You can configure the SW to work with almost any scanner using the configuration screen.**



If your radio has an AM/FM/WFM key, your manual will describe what mode is set by default for the various frequency ranges. Enter those here. Be sure to also define the AM/FM key on the HW Settings Screen. If your radio does not have an AM/FM/WFM button, make sure that you clear the AM/FM Key box on the HW Settings screen.

**FIGURE 8 — You will need to tell the software what the default modulation mode is for a given range of frequencies in your scanner model.**

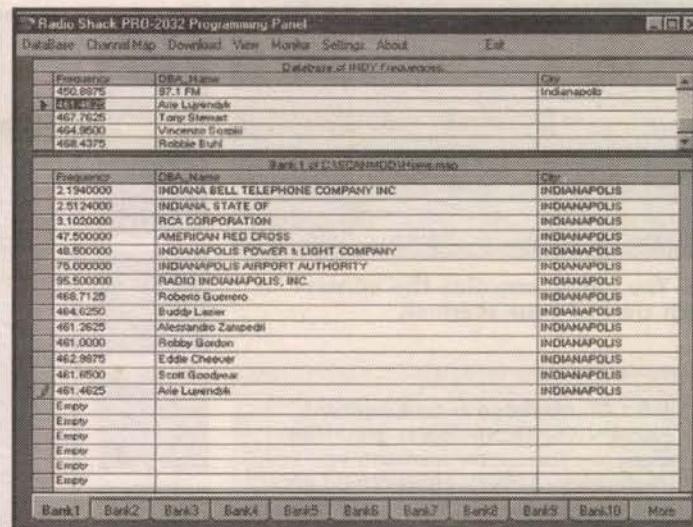
5. Next, the software needs to know the key sequences required by your radio to program a new frequency into a particular channel. Press the "Program Channel Sequence" option button and then "Record" to begin. For the PRO-2032 wired according to the schematic in this article, I press "Manual,"

software knows how to wiggle the buttons on your scanner and you are ready to run the Computer Control Software.

9. Press the "Save" button and then press "Try It." Now, when you select the boxes in the matrix, the radio should respond as if you were pressing the same keys on the radio's keypad. If the

the "Database" and "Channel Maps" pull-down menu items.

To program a frequency from the Frequency Database into the opened Channel Map, you simply drag it from one to the other. To get more information about a station in either grid, select the station and then right click any-



**FIGURE 9 — The drag-and-drop interface makes changing your channel maps a breeze.**

Selecting the "Manual" menu option brings up a customizable control panel for your scanner from which you can manually operate the scanner (Figure 11).

## Frequency Databases

With the advent of the CD-ROM and the Internet, it has become rather easy and inexpensive to find frequency databases to suit your needs. A few of these are listed in the sidebar. Unfortunately, each author has chosen to use a different database structure, so you often need special SW to access these.

PROgramit provides an Import feature to convert the most popular of these databases to the required format. Currently, the Probe, Percon, and Scanware formats can be converted. By the time you read this, other formats will be supported including delimited ASCII text which can be produced by most any database access program.

PROgramit uses Microsoft Access for the underlying database, but you don't need Access to use the SW. The current version of the program provides

## Connections for Some Popular Radio Shack Scanners

### Radio Shack PRO-2035 and PRO-2042

Connections are to the 15-pin board connector labeled CN503 (Keypad end is CN601)

Pin 15 is ground

Pin # on CN503	X0 to Pin 5	X1 to Pin 6	X2 to Pin 7	X3 to Pin 8	X4 to Pin 9	X5 to Pin 10	X6 to Pin 11	X7 to Pin 12
Y0 to Pin 1	MAN	AUTO	RECT	LIMIT	PRI	1	2	3
Y1 to Pin 2	SCAN	PGM	L/OUT	UP	MODE	4	5	6
Y2 to Pin 3	TUNE	WX	L/OUT/RW	DWN	STEP	7	8	9
Y3 to Pin 4	SOUND SQ	ENT	DEL	MON	RESET	0	.	CLEAR

### Radio Shack PRO-2004, 2005, 2006

The keypad connector is labeled CN601. This is a 13-pin connector between keypad and main PCB

Pin 13 is ground

Pin # on CN601	X0 to Pin 8	X1 to Pin 7	X2 to Pin 6	X3 to Pin 5	X4 to Pin 4	X5 to Pin 3	X6 to Pin 2	X7 to Pin 1
Y0 to Pin 9	X	MAN	PRI	LIMIT	X	1	2	3
Y1 to Pin 10	L/O RW	SCAN	SPEED	UP	PRGM	4	5	6
Y2 to Pin 11	RST	DELAY	MODE	DWN	ENTER	7	8	9
Y3 to Pin 12	MON	L/O	STEP	DIRECT	CLEAR	0	.	X

The Enter Ch Button, Program, The Enter Freq Button, Enter, Lockout, Delay." Press Stop when complete.

6. To teach the software the key sequences required by your radio to program a new search range, press the "Program Scan Range Sequence" option button and then "Record" to begin. For the PRO-2032, I then enter "Program, Limit, The Enter Freq Button, Enter, Limit, The Enter Freq Button, Enter, ScanUp." Press Stop when complete.

7. To teach the software the key sequences required by your radio to program a new Priority Channel, press the "Program Priority Sequence" option button and then "Record" to begin. For the PRO-2032, I then enter "Program, The Enter Freq Button, Priority." Press Stop when complete.

8. Finally, fill in the number of banks and the total number of channels that your scanner provides. That's it! The

radio does not respond, and you have carefully checked your wiring and installation, you may need to increase the "Delay Factor" until the radio responds reliably.

10. Press "Stop" and then "Quit" and you are ready to try the software's simple drag-and-drop interface.

### Using PROgramit

Figure 9 shows the program's main screen. Your frequency database is displayed in the upper table. The lower table displays one bank of frequencies at a time as they would be programmed into your radio along with the station's owner and city.

I refer to the upper grid as the "Frequency Database" and the lower grid as the Channel Map. You can open existing Frequency Databases and Channel Maps, or create new ones from

### Radio Shack PRO-2026

The 15-pin board connector is labeled J201

Pin 1 is ground

Pin # on CN601	X0 to Pin 8	X1 to Pin 7	X2 to Pin 6	X3 to Pin 5	X4 to Pin 4	X5 to Pin 3	X6 to Pin 2	X7 to Pin 1
Y0 to Pin 12	POLICE	FIRE	AIR	1	2	3	ENTER	X
Y1 to Pin 11	WX	MARINE	DELAY	4	5	6	CLEAR	X
Y2 to Pin 10	SCAN	PROG	L/O	7	8	9	0	X
Y3 to Pin 9	MANUAL	MON	PRO	LIM	DOWN	UP	.	X

### Radio Shack PRO-2032

The 8-pin board connector is labeled CN6

Pin # on CN6 ----> Pin 1	X1 to Pin 2	X2 to Pin 3	X3 to Pin 4	X4 to Pin 5	X5 to Pin 6	X6 to Pin 7	X7 to Pin 8
Jumpers							
Y0 to JM80	SPEED	SCAN	MAN	PRI	0	1	2
Y1 to JM84	DOWN	L/O	LIMIT	PGM	4	5	6
Y2 to JM83	MON	DELAY	UP	CLEAR	ENTER	7	8

where in that grid.

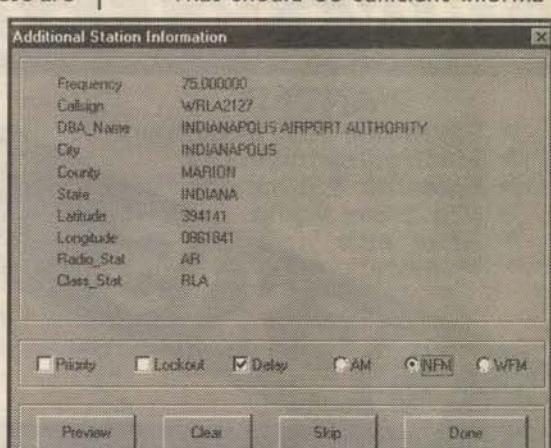
When you right click on the Channel Map grid, you will also be able to clear a channel or set its "Priority, Lockout, and Delay" options if these are supported by your radio (Figure 10).

When you have all the channels programmed the way you want them, you can choose to download one channel at a time, one bank at a time, or all of the banks at once. You can save as many custom Channel Maps set-ups as you want, and recall them later to reprogram the scanner.

From the menu bar, you can also quickly program the scanner to monitor a range of frequencies that covers aircraft, weather, 2M, or 440 amateur radio.

you with some very basic editing functions that allow you to create and edit a Frequency Database. Table 1 shows the database format.

That should be sufficient informa-

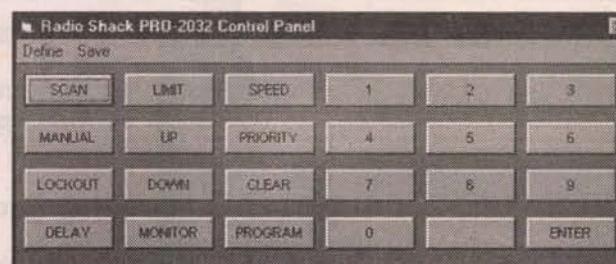


**FIGURE 10 — Right click on either grid for additional station details.**

tion for you to put this simple project together and get it running in your scanner. Once you do, you will probably never want to program it manually again.

This project would not have come together as it did without the help of a group of people on the programit@qth.net list server who helped debug the early hardware and software. Many thanks to each of you. Others can join the list by E-mailing to majordomo@qth.net with the words subscribe programit in the body of the message.

For more information on the project, you can visit the PROgramit web page at <http://www.geocities.com/SiliconValley/Way1522> or contact me via E-mail at jrmont@quest.net NV



**FIGURE 11** — You can customize the control panel to match that of your scanner.

*John Montalbano is an Electrical Engineering Technologies graduate from the Rochester Institute of Technology (1981). He received his Master's Degree in Computer Science in 1986. He has worked as a circuit designer for AT&T in the areas of videoconferencing, medical imaging, 3D graphics, and interactive television. John welcomes E-Mail at jrmont@quest.net*

### Parts List — Parallel Interface Version

Reference Designator	Description	Source
U1	74LS241	Digi-Key DM74LS241N-ND
U2	Harris CD74HCT22106	Digi-Key CD74HCT22106E-ND
U3 (Optional)	LM7805	Digi-Key NJM7805FA-ND
Used only when regulated 5V is not available in scanner.		
DI-D8	IN914 or IN4148 Diodes	IN4148CT-ND
R6	4.7K ohm 1/8 watt	
R1-R5	47K ohm 1/8 watt	
C1,C2	0.1 uF Ceramic	Digi-Key 1203PHCT-NP
Female DB-25 right angle connector.		
Perforboard (Note 2)	approx. 2- 5/8" X 4.0"	Digi-Key 325F-ND Digi-Key V1119-ND

### Parts List — Serial Interface Version

Reference Designator	Description	Source
U1	MAX233	MAX233CPP-ND
U2	E-Labs EDE300	See Note
U3	Harris CD74HCT22106	Digi-Key CD74HCT22106E-ND
U4 (Optional)	LM7805	Digi-Key NJM7805FA-ND
RZ1	Resonator	See Note
DI-D8	IN914 or IN4148 Diodes	IN4148CT-ND
R2-R6	47K ohm 1/8 watt	
C1,C2	0.1 uF Ceramic	Digi-Key 1203PHCT-NP Digi-Key 325F-ND
2-pin serial connector of your choice. Suggest female RCA bulk-head mount.		
Perforboard (Note 2)	approx. 2-5/8" X 4.0"	Digi-Key V1119-ND

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PROgramit Software and updates are distributed as shareware at the PROgramit web page. The author requests a one time \$12.00 registration fee be mailed to:

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2088X Speed

2112X Speed

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2160X Speed

2184X Speed

2208X Speed

2232X Speed

2256X Speed

2280X Speed

2304X Speed

2328X Speed

2352X Speed

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2400X Speed

2424X Speed

2448X Speed

2472X Speed

2500X Speed

2528X Speed

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2584X Speed

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3088X Speed

3116X Speed

3144X Speed

3172X Speed

3200X Speed

3228X Speed

3256X Speed

3284X Speed

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# Incoming meteors soon

by  
Gordon West

**In about 30 days from now, astronomers and radio enthusiasts are getting set for one of the biggest yearly light shows in the sky — the Geminids meteor shower.**

The week-long aerial activities may begin on December 7th, illuminate the grand finale on December 14th, and still give you some visible "shooting stars" seen through December 17th.

This yearly meteor shower will delight skygazers late at night and into the pre-dawn hours with an expected 70 visual trails to be easily seen without the need of binoculars or a telescope. And while stargazers are outside looking up, ham radio operators and scanner radio enthusiasts will be listening to the airwaves and watching the television tube on an outside antenna for signals up to 1,000 miles distant. There will be excitement for all!

## SHOOTING STARS

The earth regularly encounters incoming debris which instantly burn up into incandescents as the tiny particle as small as a grain of sand enters our dense atmosphere. The split-second streak of incandescents refers to the trail of light called a "meteor." The little speck of material is the actual meteoroid, and if it is large enough to withstand a trip through our atmosphere to actually make it down to earth, the recovered blueish-looking iron and silicon remnant is called a meteorite.

Random meteors occur every day, 24 hours a day, 365 days of the year. Random meteors are so predictably common that high-speed remote data stations rely on these meteors to reflect millisecond-long data messages between 30 MHz to 50 MHz over distances of 1,000 miles. But these kilowatt and megawatt stations are now going off the air in favor of polar-orbiting satellite relays.

Every year, our earth predictably passes through the debris of old comets, and this we call the annual meteor showers.

Name of Shower	Date of Peak	Average Hourly Rate
Quadrantids	Jan. 3	40
Lyrids	Apr. 21	10

Aquarids	May 6	12
Arietids	June 10	60
Taurids	July 2	30
Orionids	July 12	50
Aquarids	July 28	20
Persids	Aug. 14	50
Orionids	Oct. 22	30
Taurids	Nov. 5	15
Leonids	Nov. 16	12
Geminids	Dec. 14	70
Ursids	Dec. 22	12

The magazine *Sky & Telescope* will be your best source of information about what time of day the peak will occur, and in what general direction to aim your directional antennas. You can also look up meteor information at [www.imo.net](http://www.imo.net) from the International Meteor Organization.

## THE RADIO CONNECTION

While looking up at the night or early morning dark sky and seeing the trails from these incoming meteors (and quite possibly the incoming glow of satellite space junk, too), there is also major excitement out on the radio frequencies. Radio signals from 20 MHz to 250 MHz bounce off of the meteor trails and, for a few brief seconds, allow radio amateurs to conduct conversations over a 1,000 mile path on frequencies that might only support normal 10-mile contacts. And for television viewers with their TV hooked up to an outside antenna and tuned into an unused TV channel, all that white noise instantly transforms into a full-color picture that might last for as long as 30 seconds from the TV station over 800 miles away.

Same thing on the FM music band — where only 6 FM signals in your area may turn into a bedlam of incoming FM stereo stations that can be tuned in for up to a minute or two before the signals begin to fizz away. The higher you go in frequency, the shorter the reflected signal duration.

VHF signals have just the right wavelength from 10 meters down to 1-1/4 meters long to easi-

ly reflect off of the meteor trail. As the meteoroid heats up to incandescence by friction of the earth's atmosphere, electrons and ions are scrambled and glow to incandescence, leaving a trail of ionization that might reach out to 20 miles in length, creating a pencil-like mirror that reflects and refracts back to earth normal line-of-sight VHF radio waves.

Sometimes the ionized trail may only last for a few seconds, giving ham radio CW operators a brief opportunity to quickly exchange each other's call sign at 30 wpm. Sometimes larger meteoroids grazing the earth's atmosphere create longer and more lasting meteor trails that may persist up to 30 seconds and allow remarkable television and FM music radio reception over 800-mile paths.

The meteor trail is best "worked" by radio enthusiasts when it is perpendicular to the path of the radio waves. Depending on what frequency you are tuned into may determine how long you are able to sustain communications or reception off of a single meteor trail.

As an example, a remarkable Geminids meteor shower about five years ago gave us a whopping meteor trail that allowed amateur operators to carry on communications with the other distant station almost 900 miles separated for a remarkable amount of time. The operators on the lower frequency had almost a full minute to exchange signal reports and niceties, while other operators only had a few seconds. In looking over the log books and listening to tapes, here is what I've found on that one single meteor contact:

**222 MHz** — a remarkable, successful two-second CW exchange

**144.2 MHz** — 22 seconds of "armchair" solid copy

**50.2 MHz** — 45 seconds of loud and clear communications

**28.4 MHz** — 1-1/2 minutes of solid communications

**21.3 MHz** — over three minutes of rough, but copy-able, two-way radio dialogue

## THE PROCEDURE

If you plan just to watch the Geminids meteor shower, simply step outside on the nights of December 10th through the 14th, and look up to the dark sky and see where the meteor activity is. Within a minute or two, you'll get an idea of which direction they are coming from. This varies with the time of night or the just-before-dawn hours. Most reports indicate that 4:00 am to 5:00 am local time, here in the United States, will lead to some easily seen meteors.

If you plan to catch them on an entertainment radio or television, a directional antenna will help. Aim your TV or FM antenna in a direction of a major city about 700 miles away. Tune in between on-air stations, and be patient — out of nowhere a signal will come up and surprise you for several seconds.

If you're a scanner radio enthusiast, try tuning in 75 MHz. Every airport has a 75-MHz inner marker beacon that shoots a signal straight up. If you don't hear a thing on 75 MHz, just wait. All of a sudden, you may begin to hear a pulsed signal come out of nowhere, and this is probably a reflection from a Geminids meteor trail.

Amateur radio operators most reliably make contact off of meteor trails by setting up specific schedules with other stations many hundreds of miles away. The easternmost station transmits from 15 seconds to 30 seconds beaming west, and 45 seconds to 59 seconds aiming west. West Coast stations will beam east, and transmit their own call sign from 00 seconds to 15 seconds, and 30 seconds to 45 seconds. After several minutes, both stations will have received enough fractional information of the other station to confirm a meteor contact.

I like the excitement of unscheduled meteor contacts. The most popular band is six meters at 50.125 MHz, and on two meters at 144.200 MHz, both bands operating upper sideband. A no-code Technician has full privileges on both of these bands.

Working a random contact still adheres to the west calling east at 00 to 15 seconds, and 30 seconds to 45 seconds schedule. The east calls west at 15 seconds to 30 seconds, and 45 seconds to 59 seconds.

The trick is not to call for the entire 15-second period. The key is to be BRIEF AND CONCISE: "CQ meteors, this is WB6NOA in DM-13, break." I listen for a couple of seconds for a response, and then repeat this sequence again, squeezing three of them within my 15-second calling period.

I am giving my call sign, and I usually do it phonetically, along with my maiden-head grid square, the direction that I'm listening for, and the word "break" to indicate I am not doing the entire 15-second call, but rather briefly calling and briefly listening.

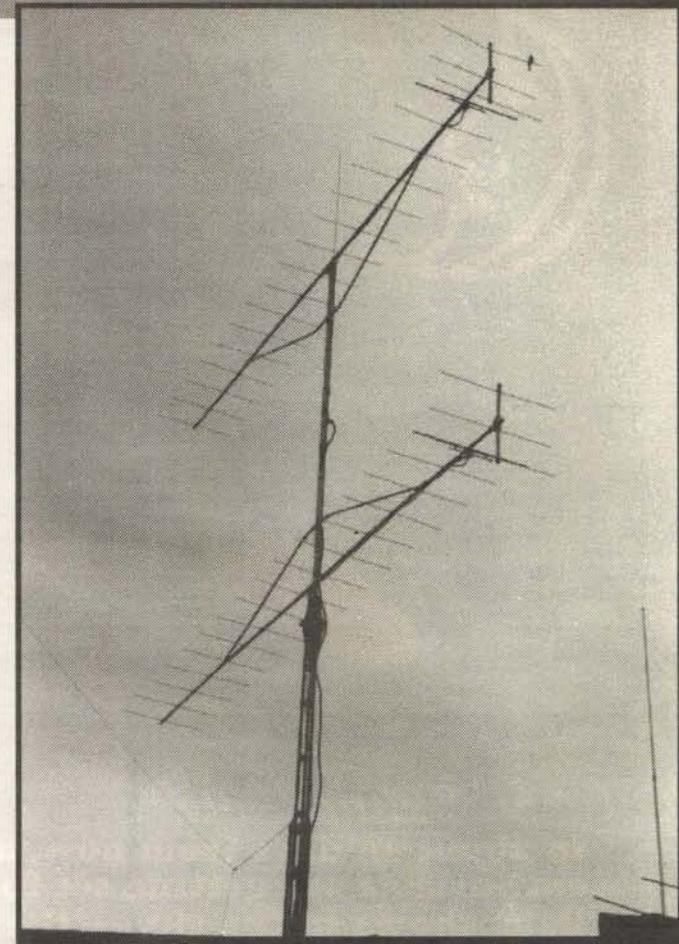
This short-shot approach works well. After about 10 tries, I usually get a fast response from another station, so I always keep my pencil ready. They indicate my signal is "S2," which is not signal strength, but rather they heard my complete exchange, and then they say the word "break" which means it's my turn to give them my response of their call sign, my call sign, my S2 of their signal, and they break for their final "roger." They give me a "roger," and I give them a "roger" plus 73, and that's that.

One fast meteor shower contact should be accomplished in less than 10 seconds. If you're taking more time than that, other hams will out-talk you and drive you off the frequency! The whole idea is to get in and get out, and let other amateur operators try to work that same station on the same "burn."

Sometimes the calling frequency gets so jammed with signals that no one can hear anything but QRM. Now it's a good idea to move 5 KHz higher or lower than the calling frequency. But don't move too far away because no one will be looking for you way up or way down the band. It's too bad that we can't spread out more during meteor scatter contacts, but the way that random contacts work is to make noise on the calling frequency.

I sometimes will kick on the amplifier, and give a 15-second transmission that I will be at a specific frequency for the next 10 minutes looking for contacts. Hopefully my signal will bounce off of a few incoming meteor trails that several stations will hear me saying I'm going to go off frequency to another specific spot on the radio dial, and they will follow me down there, and we can leisurely make a contact without jamming the calling frequency. This is good technique.

If you have not worked meteor showers before as a licensed ham, listen to the pros. You want to try to imitate their technique as best you can. During the peak of the meteor shower, most pros will develop big fangs and claws, and they'll strike out at anyone who isn't in tune with how to work



A stack of beams may be too much for meteor work, due to a very narrow beamwidth.

meteors and to get on and off of the frequency in a hurry.

A small directional antenna is about all you need, with more than 25 watts of power preferred. Fifty to 100 watts is just fine; 1,500 watts is unnecessary unless you are blasting an announcement out that you are going to be listening up or down the band a few KHz for the next few minutes. That's the technique I use, and that's about the only time I turn on "big bertha."

## SO GET SET FOR GEMINIDS

You have a month to prepare your station, and if all you want to do is to watch and listen, there's plenty of excitement without ever having to transmit over the airwaves. Every year, these different showers provide all sorts of surprises, plus some disappointments. But there are always a few good meteors out there, so see how you can next catch that falling star. NV

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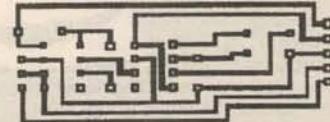
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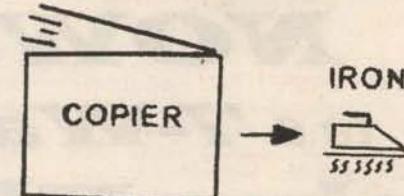


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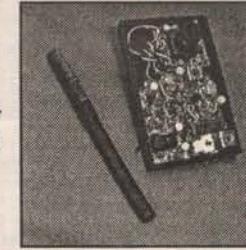
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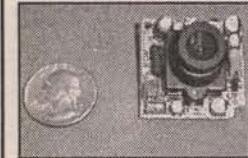
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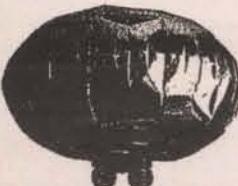
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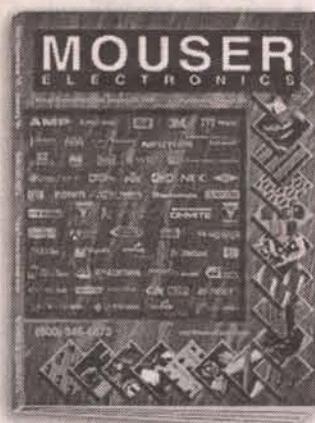
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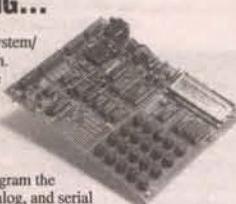
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junction(s), or short across one or more junction(s). More than 90% of the time, they will short. This makes it easy to find the bad transistor, often times in-circuit. But it is common to have to remove a transistor or diode from the circuit to get an accurate reading, due to other components such as resistors and transformers that make the component look shorted.

Some of the newer models of DVMs have capacitance checkers, but require that the capacitor be pulled from the circuit to get an accurate reading. Along those lines, a device called an ESR (Equivalent Series Resistance) meter is available and very effective for finding bad capacitors in-circuit.

ESR meters start at about \$200.00 and are used as a power-off test by applying a 50 KHz signal to the capacitor in-test, and measuring the resistance of the capacitor. Most capacitors fail due to the oil in the capacitor drying out from heat, which causes the ESR (resistance to a frequency) value to increase.

## A WORD ABOUT EFFICIENCY

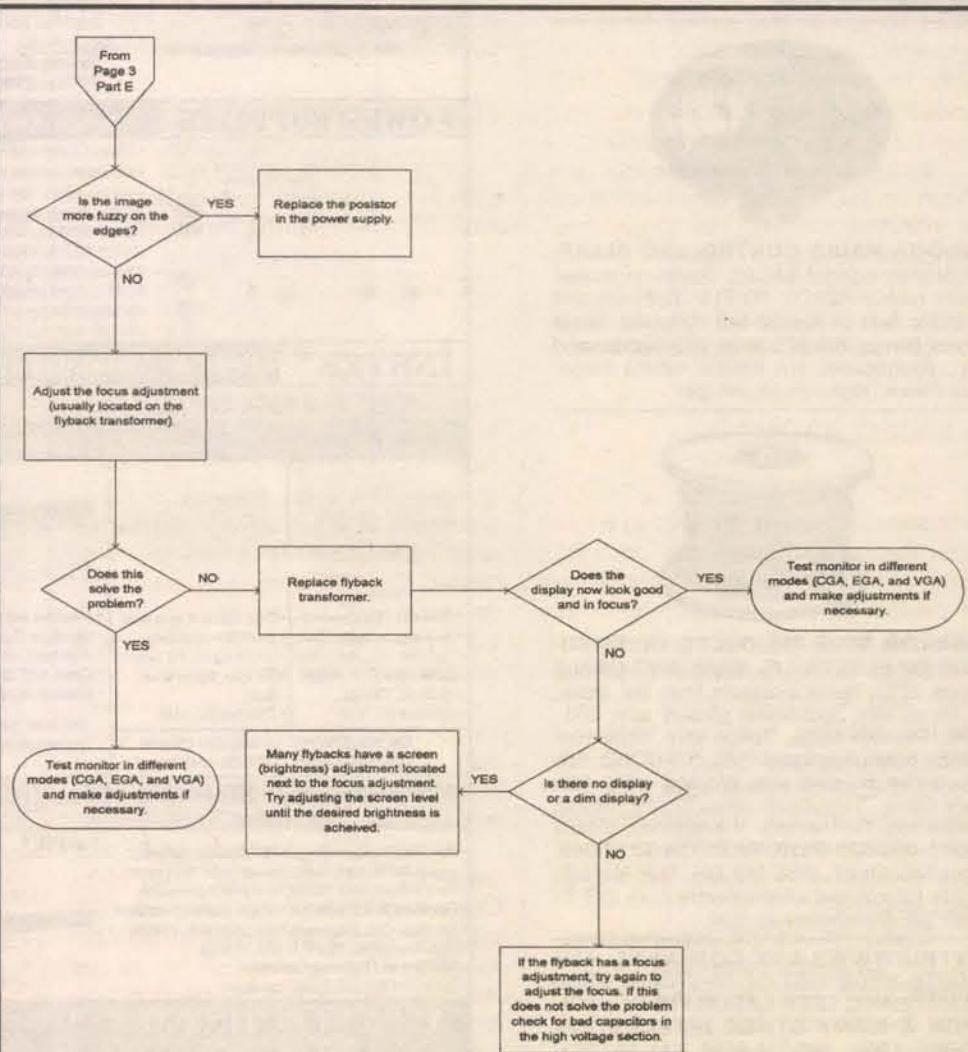
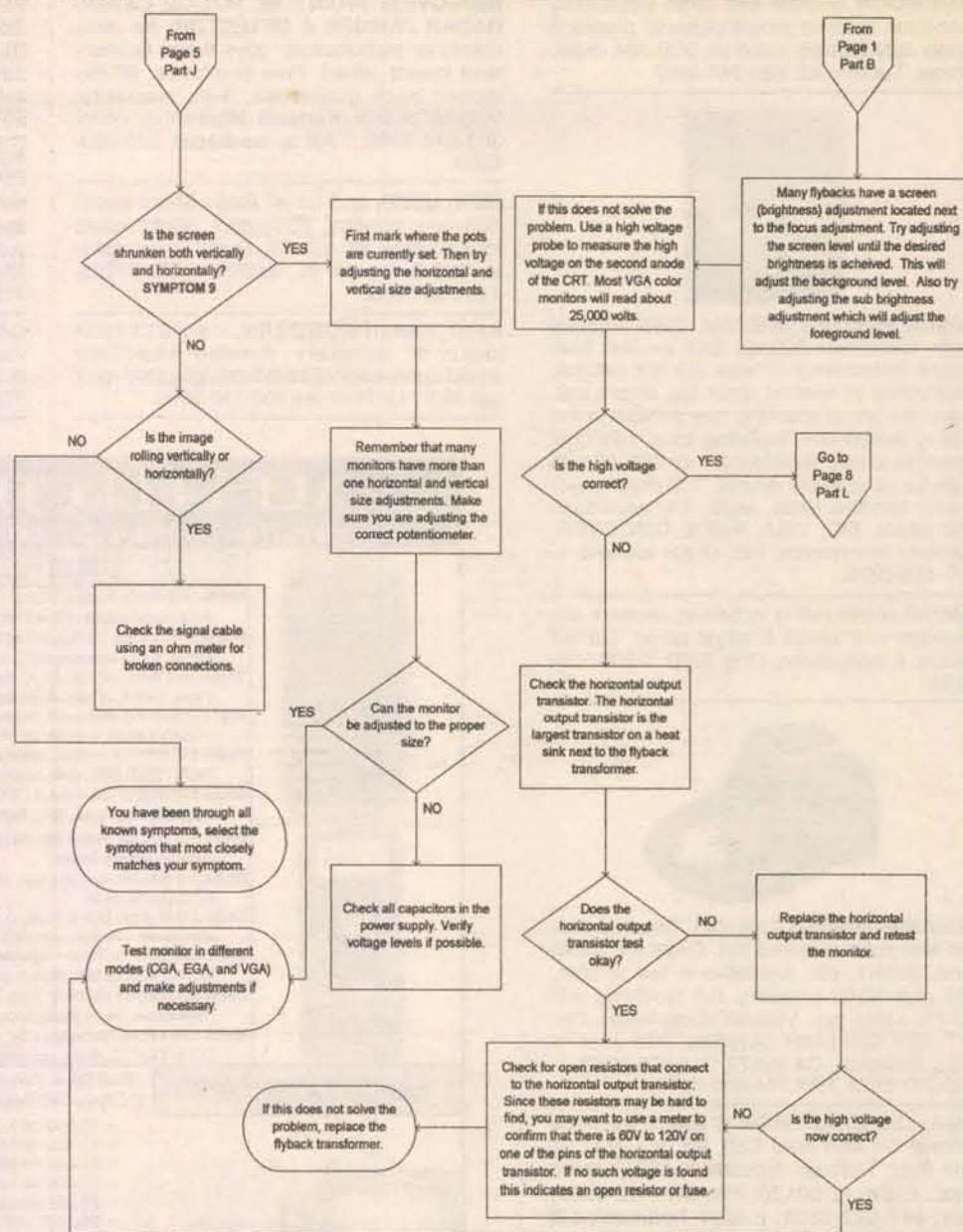
This article is intended to improve a technician's troubleshooting skills and give them an approach to repairing monitors that works. However, the most efficient method of repairing monitors does not include troubleshooting. The most efficient way to repair monitors is using a database you have created with each repair done.

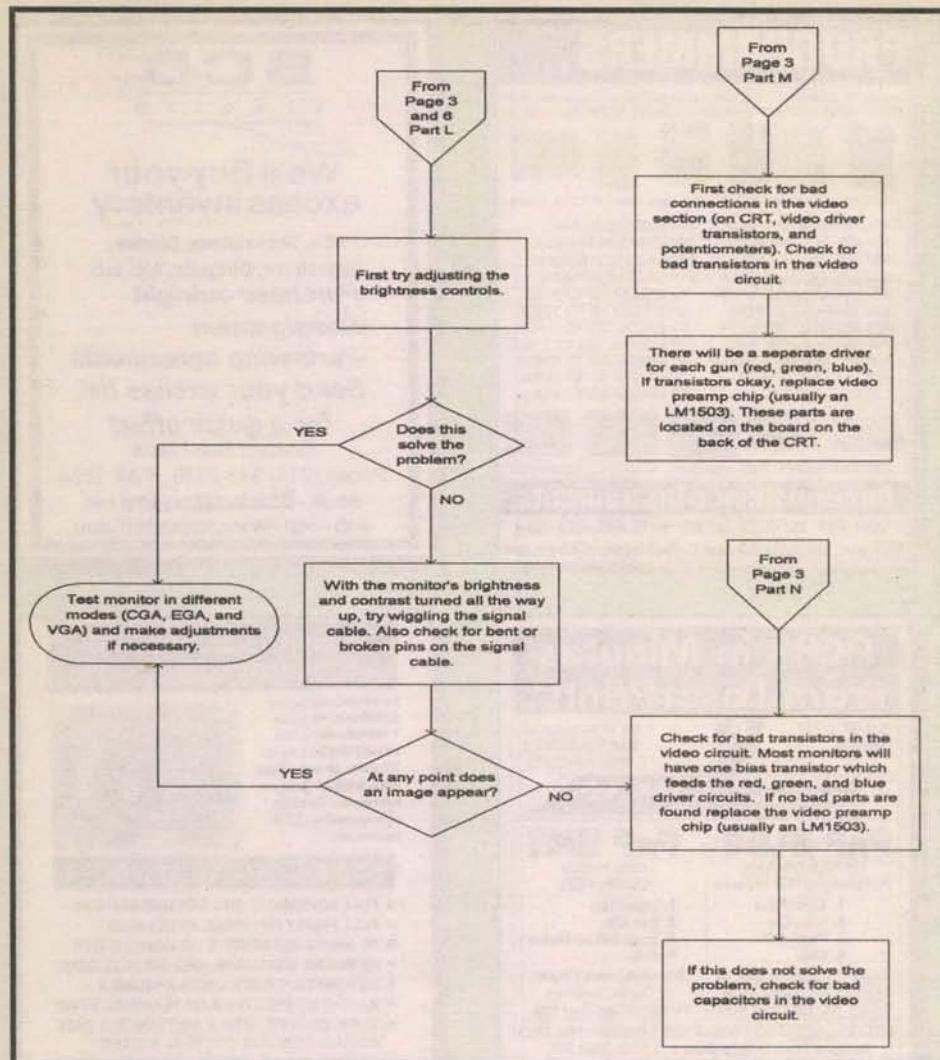
By creating a database containing make, model, symptom, and solution (and possibly serial number) of each monitor you repair, soon most of your fixes will not require any actual troubleshooting. So the only time involved in a repair is that of replacing the parts and not trying to find the bad parts. NEVER TROUBLESHOOT THE SAME PROBLEM MORE THAN ONCE. It is for this reason we at NAC have spent over 12 years compiling a list of fixes for monitors, system boards, drives, and power supplies.

## TECH TIP APC 95

Recently, we have seen a high failure rate on CTX 1461 and 1561 monitors. The problem is caused by bad connections in the power supply and will usually cause a diode ZD101 and transistor Q101 in the power supply to short and blow the fuse (about \$7.00 in

Continued from page 14





parts). This problem can be prevented by resoldering the five connections on both sides of P104.

P104 is a connector that connects the switcher board to the main board. The switcher board must be removed from the circuit in order to get to the connections on the switcher board side of P104. After removing the old solder and resoldering these connections, the switcher board can be reinstalled.

If this is not done, chances are the monitor will fail when bumped or vibrated, causing the diode and transistor to fail. In about 10% of these failures, a resistor at R114 will open, causing about seven other components on the switcher board to fail.

## A WORD ABOUT DAS

DAS stands for Digital Adjustment System. It refers to monitors that use software run on a PC (and usually some special hardware or cables) to make adjustments that used to be done with pots in the monitor. Both Goldstar (Packard Bell) and Viewsonic have recently started making monitors that use DAS. You may have seen Goldstar or Packard Bell monitors with bad digital control circuits. We have recently seen a large number of these monitors exhibiting problems with their control panels.

If you replace the chip that causes the problem, you will find it solves your original problem, but now the monitor has a vertical roll. This is because the chip you just

replaced contains the memory that stores these adjustments. The only way to fix this problem is using a special software and box that connects to the PC. We have not gotten far trying to get these products from the manufacturer, so we've started making our own and expect to be selling them soon.

## TEST EQUIPMENT

The following is a list of highly effective, low-cost test equipment available for repairing monitors.

### ESR METERS

A low-cost ESR meter is the best investment any technician can make for working on monitors. ESR stands for Equivalent Series Resistance, for those that have an electronics background. This is an equivalent measurement of a capacitor's reactance value (measured in ohms of resistance). Over 95% of the time, when an electrolytic capacitor fails, it dries out from heat in the circuit. This will usually not show up as a change in the capacitance value, but instead, when capacitors dry out, their internal resistance to a frequency increases making them more resistive and less capacitive.

Most ESR meters put out between 50 KHz and 100 KHz. Capacitors over 1 uF have an ESR value of under 10 ohms (at 50 KHz to 100 KHz generated by these testers). This makes the chance of a resistor in circuit affecting the readings unlikely. For this reason, ESR

meters can be used to test capacitors in circuit with a high rate of accuracy.

Meters that measure the capacitance value are useless to the technician since the capacitor has to be removed from the circuit to get an accurate reading. If you have to remove a capacitor from the circuit for testing, you might as well replace it for the \$.20 replacement cost and save the time spent testing the cap.

Creative Electronics - \$199.00  
810-435-8916

## VI TESTER (OCTOPUS)

Another device that is helpful in troubleshooting monitors (and other analog circuits) is the VI tester. They are also called an Octopus, and are sold by Huntron as the Tracker 1,000, 2,000 and 5,000 models. The Huntron Trackers start at about \$1,000.00 and go up to about \$6,000.00. They are better than the simple VI testers with more ranges and more features, but they are expensive.

A simple VI tester with a built-in switcher (for doing a comparative test between a good and bad unit) can be built for under \$70.00 and connected to any scope that supports XY settings. NAC sells a VI tester that connects to a scope and includes a built-in switcher for comparison testing for \$145.00.

## PATTERN GENERATORS

You have two options for pattern generating: 1. Software-based products that run on a PC. 2. Hardware-based products that are self-contained. The software option is cheaper, but not as efficient as a dedicated hardware device. However, the software option usually has more flexibility and more tests than a hardware-based device. You may want one of each (hardware and software).

Tech Assist (Software) - \$295.00  
800-274-3785  
CMM (Hardware) - \$295.00  
800-466-4411

The longer I work in the repair industry, the more apparent it becomes that you do not have to spend a lot of money to work efficiently. In fact, as I have discovered new products over the years, it seems that the most useful tools are the least expensive. NV

*Don Doerr, President of National Advancement Corporation, a Santa Ana, CA-based company that specializes in Advanced PC, Monitor, Macintosh, Printer, and Network maintenance training. NAC also makes test equipment and video tapes for the service industry. For information about NAC products and services call (800) 832-4787. Mr. Doerr is also Spokesperson for NAPCO, author of the book, "Servicing PC-based Equipment" (published by Prentice Hall), host of "The Computer Consultant" radio show, and works as a consultant for CBS, NBC, and Fox Television Networks.*

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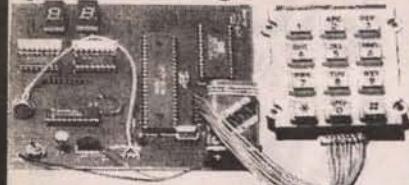
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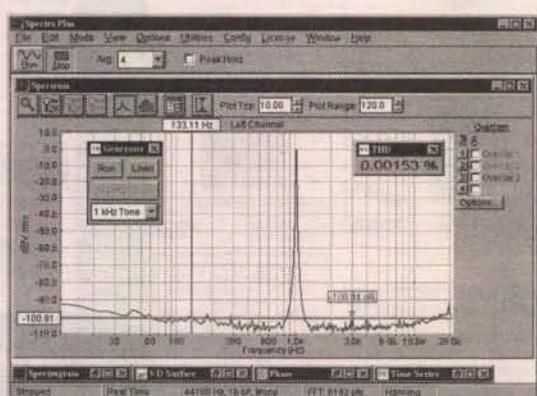
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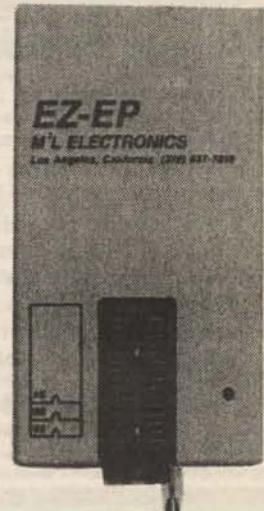
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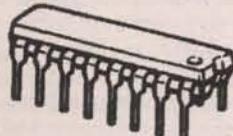
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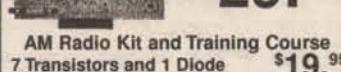
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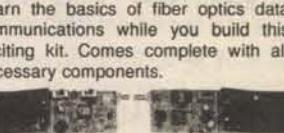


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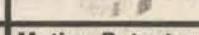


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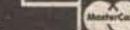
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## Questions & Answers

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## QUESTIONS

I have an analog fuel injection computer that fires two throttle body injectors alternately. The computer sends out one pulse width every two crank revolutions for each injector.

I want to add an outboard circuit that will fire eight injectors sequentially [firing order 1-8-4-3-6-5-7-2], maintaining the original computer-generated pulse width I can use two reluctor or optical-generated pulses from the camshaft for the #1 cylinder firing reference.

11971

Joe Riedi  
Renton, WA

I have a voice-changing device that outputs its audio to an external 8 ohm speaker. This system works like a small megaphone. I create a lot of voice mail greetings using this device, and it allows me to alter the voice characteristic, but it's cumbersome holding the mini speaker to the telephone handset with the other.

I want to feed the output of the LM386 audio chip, eliminating the speaker, into the handset mike through a phone jack.

The matching circuit for using handsets with the electret and carbon mikes is needed.

11972

John Was  
Palm Springs, CA

I would like to construct a circuit that would allow me to vary the phase angle of a fixed 115 VAC 400 Hz power supply, where I can use any of the input phases as reference and I could shift the output 90, 180, 270 degrees lead or lag. I have used two variacs, but I find it costly and time-consuming every time that I have to set this circuit up.

11973

Franklin A. Rivas  
Hollywood, FL

I'd like to monitor a room with a small child. I have a little black and white CCD video module that has video out via a coax cable and requires +12 volts DC. Is there any way to ride the +12 VDC on the video signal coax cable? This would save me the trouble of having to run two lines. Also, what kind of length can I expect to get? I need about 20'. Will I need some sort of amplifier or driver?

11974

Bob  
via Internet

What components would be need-

ed to develop an FM stereo receiver to pick-up FM signals on a cable or antenna TV system? Then, taking this FM signal and amplifying it to speakers or perhaps a stereo set thereby, giving me FM stereo for my non-stereo TV set. We have cable service with the converter set to channel 3 input to our TV set. If a schematic or commercially available kit can be ordered, I need addresses.

11975

James Waite  
Eau Claire, WI

I am trying to build a wind generator to feed back into the power line to reduce my electricity costs here in Oregon. [The power company has to buy my power at the retail rate.] I need a schematic for a synchronous inverter to do this. I have been unable to find such a thing. Can anyone help?

11976

David Bennett  
Astoria, OR

Can someone tell me how to test the safety interlock module used on lawnmowers? These modules are approximately 1" in diameter x 1" long with three leads. The ones for Briggs & Stratton are different from Tecumseh/Kohler. What can be used to remove the sealer from these modules?

11977

Bob Finley  
Henderson, KY

Can VCR video tapes be put on to a computer disk/CD? I have seen computer catalogs advertise computers with 2 MB video RAM. I've also seen computers displayed with video being ran on the monitor, and I've heard of the President's speech broadcasting over the Internet. Yet, I'm told a computer cannot hold video, only freeze frame pictures. Is this so and why?

11978

Jim Cooper  
Haynesville, LA

I am interested in electrical discharge machining (EDM). I want to improve my amateur machining capabilities by constructing a small "shop made" EDM. I understand the basic theory of EDM. I am also comfortable with analog, digital, and motion control. I am looking for practical block and/or schematic diagrams and some hints on the implementation of the pulse control circuits and microprocessor interface. The power range need not be large.

11979

David R. Howland  
Aptos, CA

## ANSWERS

### ANSWER TO #109718 - OCT. 1997

If you are using a Radio Shack computer from the same era [i.e., the Tandy 1000 or Color Computer series], then it should have a ready-to-use RCA line-out jack. It will work with any television with line-in RCA capability. If your television doesn't have line-in, then you can purchase an RF modulator (Radio Shack cat. #15-1273A) which will convert the signal to VHF channel 3 or 4. A VCR would also perform the same trick. [This is how I used my Tandy 1000 back in '89.] If your computer doesn't have an RCA jack, then you will have to purchase a more expensive converter.

Chuck Homic  
Ballston Spa, NY  
chuck@visions.com

### ANSWER TO #10976 - OCT. 1997

It's true that an SCR can be used to switch DC loads, but only under certain conditions.

Recall that an SCR (Silicon Controlled Rectifier) functions as a diode, with one additional control electrode. Once switched into conduction, the SCR will continue to conduct until it is commutated or the holding current drops below a critical value determined by the particular device being used.

For AC circuits this is easily accomplished since the voltage reverses every half cycle, and since the SCR is a diode and doesn't conduct in the reverse direction, it turns off.

I'm not clear on how Melvin has connected his circuit or what he meant by his description of "using a capacitor to drop the voltage so the SCR could close," but using a capacitor and another SCR is one way to commutate the conducting SCR. Triggering the SCR into an on state is the easy part. Turning it off when a DC current is flowing is the harder part.

One way is to shunt current from the SCR that's carrying the main current so that the current will drop below holding value and the SCR will turn off. Using a capacitor (must be discharged to begin with) in series with an SCR in parallel with the main SCR is one way. When the second SCR fires, the capacitor will initially appear as a short, being charged through the second SCR. This will shunt current away from the first SCR, causing it to turn off. Once the capacitor on the second SCR is

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- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

charged, the current through that SCR drops to zero and it turns off. The first SCR can then be turned on again as needed.

Note that the capacitor must be discharged before it can again be used to commutate the first SCR.

Use of a hexfet or other power device might be more practical since it sounds like the voltage and current Melvin is trying to switch are easily within reach of these devices. There are also GTO (gate turn off) devices that perform like SCRs, but with the added

# TECH FORUM

capability to be turned off on command.

Richard Nelson  
Newport News, VA

## ANSWER TO #10974 - OCT. 1997

The rotary tuners had a few I/O items: ANT, OUT, Power, Ground, and AGC.

The AGC voltage is related to signal strength. The sub-tuner may fix this voltage and make a SS meter impractical. Differentiating from power (a constant V) and the Automatic Gain Control Voltage (AGC) should not be difficult. If you find it add a DC meter at this test point.

On a solid-state tuner add digital band switching and tuning voltages to the above signals.

Ron Dozier  
Wilmington, DE

## ANSWER TO #109717 OCT. 1997

The easiest way to start (or stop) your VCR is with a simple two-wire connection. If you pop the front cover off of most VCRs, you will find that all of the control switches are nothing more than two contacts usually of the membrane type. Tracing the wires back to the board, you install two separate wires to the board and a normally open phono jack or any two-wire jack to these wires and attach it to the body of the VCR.

This allows you to connect the standard output from any motion detector's "N/O" switch contacts to this jack which, in turn, will start your VCR upon triggering. Having the phono jack allows quick disconnect for use of the VCR elsewhere.

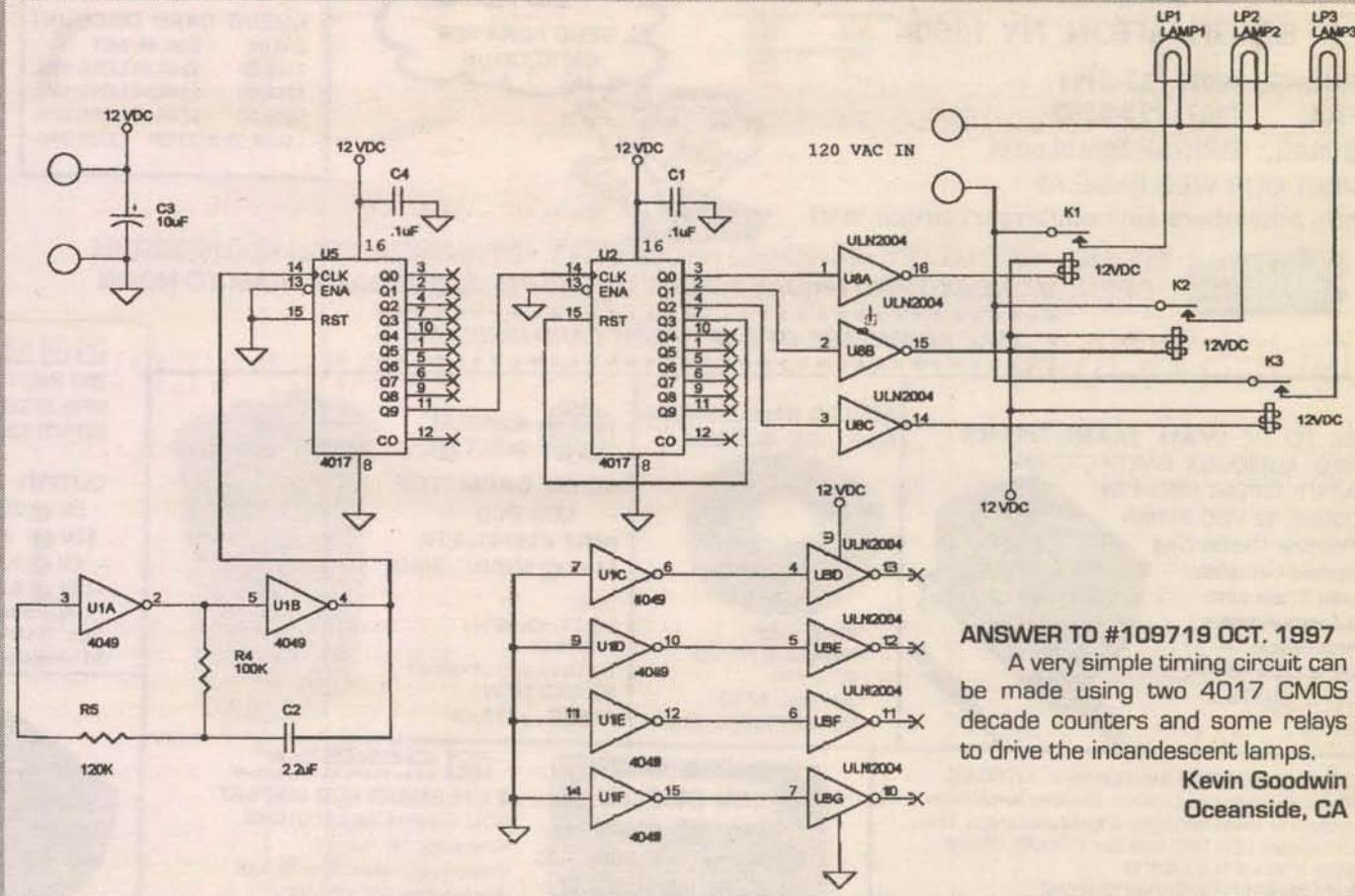
Chris  
Bieber, CA

## ANSWER TO #10971 - OCT. 1997

I don't know what kind of computer you're using, but if it's a PC compatible, you're going to have some trouble. Because of the way the PCs are designed, you can't have multiple devices that use the same system resources.

In the case of video adapters, you will have to worry about the system memory address that each card's VRAM will map to. For example, a CGA adapter uses OB800h, VGA uses OA000h and OB800h, and monochrome uses OB000h. As a result, you can use a monochrome monitor as a second monitor in a system that uses CGA or VGA. [Because the video addresses don't conflict.] Unfortunately, you need software that is specifically programmed to support dual monitors.

Many commercial debugging packages support dual monitors, so you can execute a program on your main video adapter, while viewing program data and source code on the second monitor. However, if you are writing your own software to use this setup, you can simply use address OB000h for monochrome, and OB800h or OA000h for CGA or VGA, and the computer will



## ANSWER TO #109719 OCT. 1997

A very simple timing circuit can be made using two 4017 CMOS decade counters and some relays to drive the incandescent lamps.

Kevin Goodwin  
Oceanside, CA

write to the correct monitor. To support multiple mice, I believe you will again have to delve into custom code. While you can physically connect two mice [on COM1: and COM2:], there will be a driver problem. Mouse drivers are set up to control interrupt 033h, only expecting one mouse to be used, and therefore have no provision to choose which mouse is being accessed. Perhaps an inexpensive network would

be a simpler solution? You could purchase a second computer [with only minimal RAM and HD so you can run a monitor, mouse, and keyboard].

Two ethernet cards, a null hub, and cables can be obtained for under \$75.00.

I found this configuration to be much easier to construct, and far better in terms of software compatibility.

Chuck Homic

Ballston Spa, NY  
chuck@visions.com

## ANSWER TO #10973 - OCT. 1997

Pinouts of the two seven-pin connectors on 1980's MOPAR auto radios are as follows.

GRAY connector (pin 7 is the one with the bump) is mostly for power:

Pin 1 - +13.8V to battery, hot all the

*Continued on page 110*

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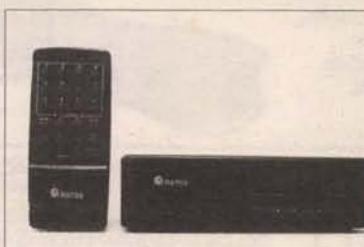
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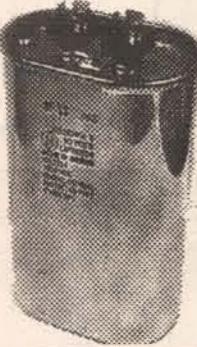
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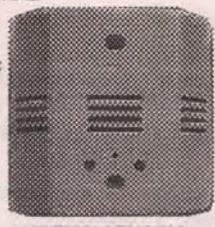


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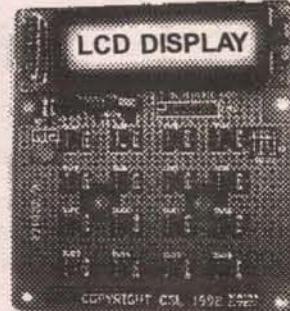
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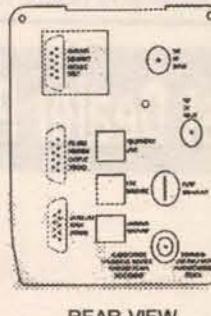
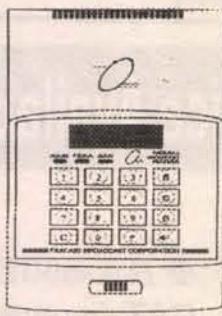
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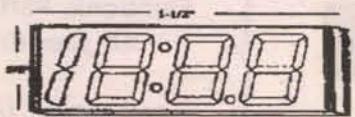


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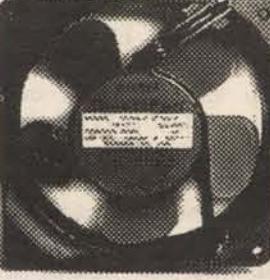
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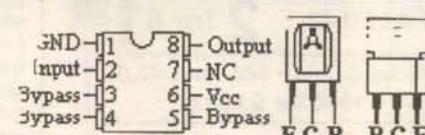
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Jerrold: 400, 450, 550	\$4.50	\$4.00	\$3.75
CFT: 2XXX	\$4.95	\$4.50	\$4.25
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S/A: 8600 Original	\$5.95	\$5.50	\$5.00
Zenith (ALL)	\$4.95	\$4.50	\$4.25
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Pioneer: Made in Korea	\$5.95	\$5.50	\$5.00



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18 VAC, 300 MA P/S	\$3.00	\$2.50	\$2.00
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PIC16C56	\$2.35	\$2.30	\$2.25
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4 MHz (Resonance 2 pins)	\$0.45	\$0.40	\$0.35

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317-299-8827

MA - HYANNIS - Computer Show. Tara Hyannis.  
Northern Computer Shows 508-744-8440

## DECEMBER 1997

### DECEMBER 6

AL - DOTHAN - Hamfest. Tom Tucker KA4YES.  
Web: <http://www.qsl.net/warc>  
AZ - MESA - ARRL Hamfest. Gary Roberts AB7MX,  
602-827-2195

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

IL - JACKSONVILLE - Hamfest. Jonathan Turner Jr. High School, 664 S. Lincoln Ave. 8am-2pm. Kaye Green KB9KHQ, 217-245-6778

LA - MINDEN - ARRL Hamfest. Lowell A. "Dusty" Collins KB5WFE, 318-371-0636

NC - GREENSBORO - Hamfest. Greensboro Coliseum Complex, 1921 W. Lee St. 910-851-1676

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**VERY SPECIAL PRICE  
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MI - HAZEL PARK - ARC Swap & Shop. Hazel Park High School, 23400 Hughes St. 8am-2pm. Tom Austin N8TMQ, 810-293-7398

NY - WHITE PLAINS - Computer Show. Westchester County Ctr. 9:30am-4pm. MarketPro 201-825-2229  
**DECEMBER 6-7**

CA - SACRAMENTO - Computer Show. Cal Expo. 10am-5pm. MarketPro 415-456-6730  
NC - CHARLOTTE - Computer Show. Charlotte Merchandise Mart. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 7**

CA - FULLERTON - Computer Show. Sequoia Conference Center. 1535 Deepark Ave. Paul Martinez 619-295-1221  
CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857  
CA - SAN DIEGO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730  
MA - TAUNTON - Computer Show. Holiday Inn.

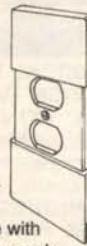
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Leviton # 830-86022  
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This handy light activated alarm buzzes intermittently when exposed to light. Use it in desk drawer, gun rack, medicine cabinet, refrigerator, school locker or file cabinet to prevent children or unwanted intruders from being where they don't belong. Red plastic case with self-adhesive Velcro backing. 2.5" x 3" x 0.84". Operates on 9 volt battery (not included). Good-looking retail packaging.

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### Twist-On F-56 Connector



Twist-on co-ax connector for RG-6 cable. CAT # FTO-56R

**100 for \$15.00**  
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FL - LAKE CITY - Hamfest & Computer Show. National Guard Armory. 8am-4pm. Colin Boutwell WA5RKR, 904-755-7969 1-800-752-7969. E-Mail: wa5rkr@isgroup.net

IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827

MA - WEST SPRINGFIELD - Computer Show. Eastern States Exposition. MarketPro 201-825-2229

ME - PORTLAND - Computer Show. Portland Expo. Northern Computer Shows. 978-744-8440

SC - UNION - Hamfest. Roger Gregory KD4YFB, 864-427-1462

**DECEMBER 14**

CA - LANCASTER - Computer Show. Antelope Valley Frnds. 10am-5pm. MarketPro 415-456-6730

CA - SAN DIEGO - Computer Show. Scottish Rite Ctr. Paul Martinez 619-295-1221 Fax 619-295-7726

CA - SANTA ROSA - Computer Show. Sonoma Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730

IN - KOKOMO - AGI Computer Fair. Ramada Inn, 1709 E. Lincoln. 10am-3pm. 317-299-8827

NH - DURHAM - Computer Show. Whittemore Arena UNH. Northern Computer Shows. 978-744-8440

NY - HEMPSTEAD - Computer Show. Best Western. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 20**

CA - OAKLAND - Computer Show. Oakland Convention Center, Broadway @ 10th St. 1-800-243-7041 Web: <http://www.robertaustin.com>

CA - SACRAMENTO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

NH - SEABROOK - Computer Show. Seabrook Greyhound Park. Northern Computer Shows. 978-744-8440

NY - BUFFALO - Computer Show. Hamburg Fairgrounds. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 20-21**

CA - VENTURA - Computer Show. Ventura Fairgrounds. 10am-5pm. MarketPro 415-456-6730

GA - KENNESAW - Computer Show. Outlet Mall, I-75 @ Exit 117. Georgia Mountain Productions 706-838-4827

NY - STONY BROOK - Computer Show. SUNY Stony Brook. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 21**

CA - RICHMOND - Computer Show. Memorial Auditorium. 10am-5pm. MarketPro 415-456-6730

CA - STOCKTON - Computer Show. Civic Auditorium. 10am-5pm. MarketPro 415-456-6730

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NY - ROCHESTER - Computer Show. The Dome Center. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 26-27-28**

MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

**DECEMBER 26**

MA - ROCKLAND - Computer Show. Sons of Italy Hall. Northern Computer Shows. 978-744-8440

**DECEMBER 27**

CA - BAKERSFIELD - Computer Show. Kern Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730

NH - MANCHESTER - Computer Show. Center of NH Expo. Northern Computer Shows. 978-744-8440

NC - FAYETTEVILLE - Computer Show. Cumberland County Civic Center. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 27-28**

CA - SAN DIEGO - Computer Show. Scottish Rite Center. 10am-5pm. MarketPro 415-456-6730

CA - VALLEJO - Computer Show. Solano Co. Fairgrounds. 10am-5pm. MarketPro 415-456-6730

NJ - PARSIPPANY - Computer Show. Parsippany Hilton. 9:30am-4pm. MarketPro 201-825-2229

**DECEMBER 28**

NH - WORCESTER - Computer Show. Worcester's Centrum Centre. Northern Computer Shows. 978-744-8440

SC - FLORENCE - Computer Show. Florence Civic Center. 9:30am-4pm. MarketPro 201-825-2229

## JANUARY 1998

**JANUARY 2-3**

MN - ROCHESTER - Super Computer Sale. Mayo Civic Center. Blue Star Productions 612-788-1901. Web: <http://www.supercomputersale.com>

**JANUARY 3-4**

FL - FT. MYERS - ARRL Hamfest. Colleen Sammons KQ4TR. 941-936-1431

**JANUARY 3**

NH - NASHUA - Computer Show. Sheraton Tara Hotel. Northern Computer Shows. 978-744-8440

**JANUARY 4**

IN - SOUTH BEND - ARRL Hamfest. Bob Denniston KA9WRN. 219-291-0252

MA - HYANNIS - Computer Show. Tara Hyannis

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Panorama City 91402  
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#72-7051



#72-7043



### Current Meters

Inexpensive ammeters are ideal for any DC current measuring application including charging systems. Induction type sensing only requires cable to be placed in slot frame on the rear of meter case, no electrical connections or leads to hook up.

#### Order #

72-7051

72-7043

#### Current range

-100~0~100 Amp

-30~0~30 Amp

### Round Analog Panel Meters

These meters feature rugged steel backs, U-clamp flush mounting, fade proof lithographed metal dials and glass fronts. Dimensions: 2" (D) x 1.5" (D). Accuracy 5%.

#### Order #

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72-7048 0~50VDC

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### TENMA® Manual Ranging DMM

Features 3½ digit LCD display, DC voltage measurement up to 600V, transistor, diode and battery test. Also measures AC voltage to 500V, DC current to 2A, and resistance to 2000Kohm. Holster, manual and test leads included. Requires one 9V battery not included (#290-080).

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#### Shielded Woofer

This high quality polypropylene cone woofer features rubber surround and shielded magnet, making it ideal for home theater applications. Great for

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Replaces Hot Spot, Bullfrog, Legend and Bose type stage monitors. Features a treated cloth surround and paper cone. Magnet weight: 17.7 oz. Voice coil: 1" 8ohm. Power handling RMS/peak 50W/100W. Frequency response: 80Hz~15KHz.

#### Order #

55-1595

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85 channel cable converter features channel memory, infrared remote and switched AC outlet. Remote requires two "AA" batteries.

#### Order #

33-2065

#### Reg.

\$59.95

**\$49.95**

Prices effective November 1 through December 19, 1997.

To take advantage of special pricing on the items listed, you must provide this code: NVM15

Allinco magnet speakers commonly used in portable radios, tape recorders or projects. All have 8ohm coil. Many other sizes and ferrite magnet versions available.



Order #	Size	(ea.)
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52-105	2½"	\$1.69
52-115	3"	\$1.89
52-120	3½"	\$2.29



### 2 Amp Power Supply

Ideal for powering projects, or for use as a battery eliminator. Regulated output is switchable to 3, 4½, 6, 7½, 9 or 12 volt.

(ea.)

\$16.95



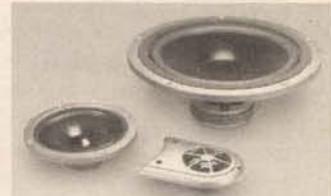
### 110 Watt Subwoofer Power Amp Module

MCM now offers the ultimate subwoofer power amp module for all your home audio and home theater projects. This amp module handles either speaker level or RCA inputs and can be built directly into most any existing subwoofer enclosure, requiring a cut-out of only 10" x 7".

Order #  
50-4465

Reg.  
\$179.00

**\$159.00**



### Famous Maker Three-Way 80 Watt Speaker Set

When you want big sound from a modest size speaker, this set was developed from one of the largest names in the business. Designed for only 1 cubic foot sealed enclosure the 8" woofer, 4" midrange and 1" tweeter gives you a seamless blend of accurate sound reproduction. 8ohm, 80W RMS. Crossover not included. Model #SK800.

Order #  
58-1660

Suggested list  
(set)

\$49.00

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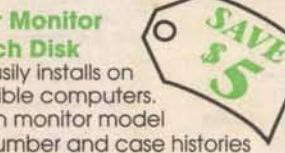
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# Radio Direction Finding

This month, we will take a look at some simple radio direction finding methods, including one that you can take along while backpacking (in case your GPS receiver fails!). But first, I want to "answer the mail" by answering a reader's question.

## WWV Preamplifier

If you follow this column any length of time, you will find that I have a passion for what I call RadioScience Observing (a term I coined to cover radio astronomy, whistler hunting, propagation observations, and the like). One of the "tricks of the trade" is to make time and radio condition recordings by listening to WWV (Fort Collins, CO) or WWVH (Hawaii) and recording the audio on one channel of a stereo cassette recorder.

The audio recording becomes a record of the data at the same time as the event is being recorded on the other channel. Some shortwave receivers even come with tape recorder outputs, although most of the time you have to use the earphone output of the receiver to drive the cassette line input jack. Neat, huh? Not always. Unfortunately, many people use low-cost shortwave receivers that don't have a large amount of sensitivity. Some homebrew designs that are popular suffer this indignity.

The reader asked me how to boost performance of the WWV receiver in the field. My first thought was a "good antenna," but that was not a viable solution given that it would have to be erected in the field and then taken down when the data collection was completed. One good solution is to build an RF preselector and preamplifier circuit such as Figure 1.

This circuit uses a low-cost JFET transistor (the venerable MPF-102 or equivalent) as the amplifier.

The input transformer (T1) is wound on a T-50-2 (RED) toroidal core. The primary is wound with six turns of #28 enameled wire, while the secondary is wound with 18 turns.

The secondary is resonated by the combined capacitance of C1 (a trimmer), varactor D1, and the

stray capacitances in the circuit. The varactor is a type NTE-618. The "NTE" series of semiconductors are intended for radio-TV/electronic service technicians, and are widely available both by mail order and in local parts distributors.

The NTE-618 is a varactor with a maximum capacitance near 400 pF. As a result, when the TUNING VOLTAGE is varied from 0 to +12 volts DC, the preamplifier will tune from a bit below 5 MHz to a bit more than 15 MHz. It will, therefore, cover the 5-MHz, 10-MHz, and 15-MHz WWV/WWVH signals. The ends of the tuning range are close to the desired minimum and maximum frequencies, so stray capacitances may prevent getting all three WWV/WWVH frequencies.

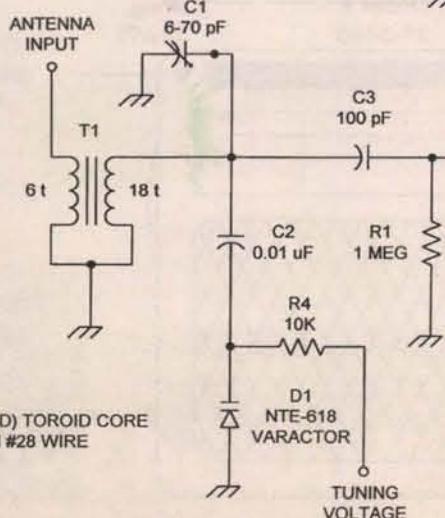
In the prototype that I built in Joe's Basement Therapy Laboratory (where I go to let the wind outta my head), it worked from about 4.9 to 15.1 MHz.

The drain circuit of Q1 is coupled to the mixer stage to follow, or the receiver antenna input, by another transformer. You can either use one like T1, but reversed (the primary becomes the secondary), or use one of the Mini-Circuits Laboratories T-series transformers. The pinouts shown in Figure 1 reflect the T-612 transformer. You can get information about the RF transformers, plus anything else Mini-Circuits makes, by checking out their world wide web page (type "minicircuits" into your search engine).

## Radio Direction Finding

Radio direction finding is the art and practice of either locating yourself or a radio station by using a directional antenna. When the FCC wants to locate an illegal station that is transmitting, they will use radio direction finders to triangulate the position. If they find the bearing from two stations they will locate the station at the intersection. However, there is a fair degree of ambiguity in the measurement. As a result, radio direction finders typically use three or more (hence "triangulate") sites. Each receiving site that can find the bearing to the station

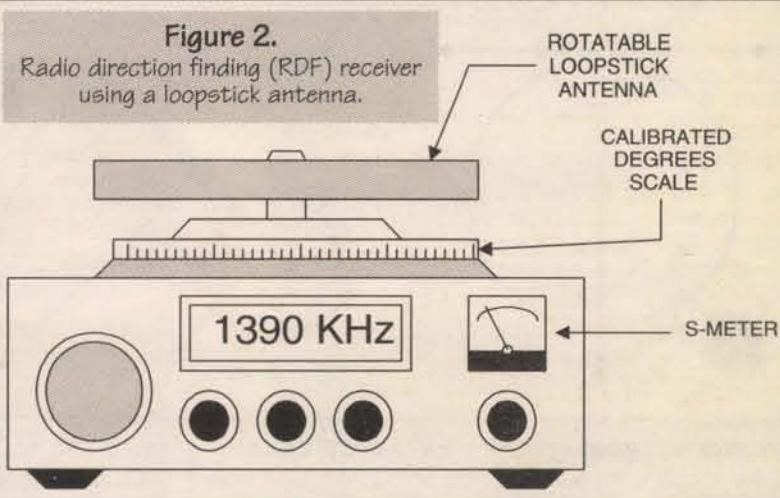
**Figure 1.**  
WWV/WWVH 5 to 15 MHz preamplifier.



T1: T-50-2 (RED) TOROID CORE WOUND WITH #28 WIRE

# Open Channel

by Joseph J. Carr  
K4IPV



**Figure 2.**  
Radio direction finding (RDF) receiver using a loopstick antenna.

reduces the overall error.

At one time, aviators and seamen relied on radio direction finding. It is said that the Japanese air fleet that attacked Pearl Harbor, HI on December 7, 1941, homed in on a Honolulu AM radio station.

During the 1950s and early 1960s, AM radios came with two little "circled triangle" marks at the 640-KHz and 1040-KHz points on the dial. These were the "CONALRAD" frequencies that you could tune to in case of a nuclear attack (right before you kissed your butt goodbye, I suspect).

All other radio stations were off the air except the CONALRAD stations. The enemy was prevented from using these frequencies for RDF because the system used several stations that transmitted in a rapidly rotating pattern. No one station was on the air long enough to effect a "fix." The result was a wavering sound to the CONALRAD station (which we heard during tests) that would confuse any dirty, smelly bad guy who tried to DX his way into our cities with a load of nukes.

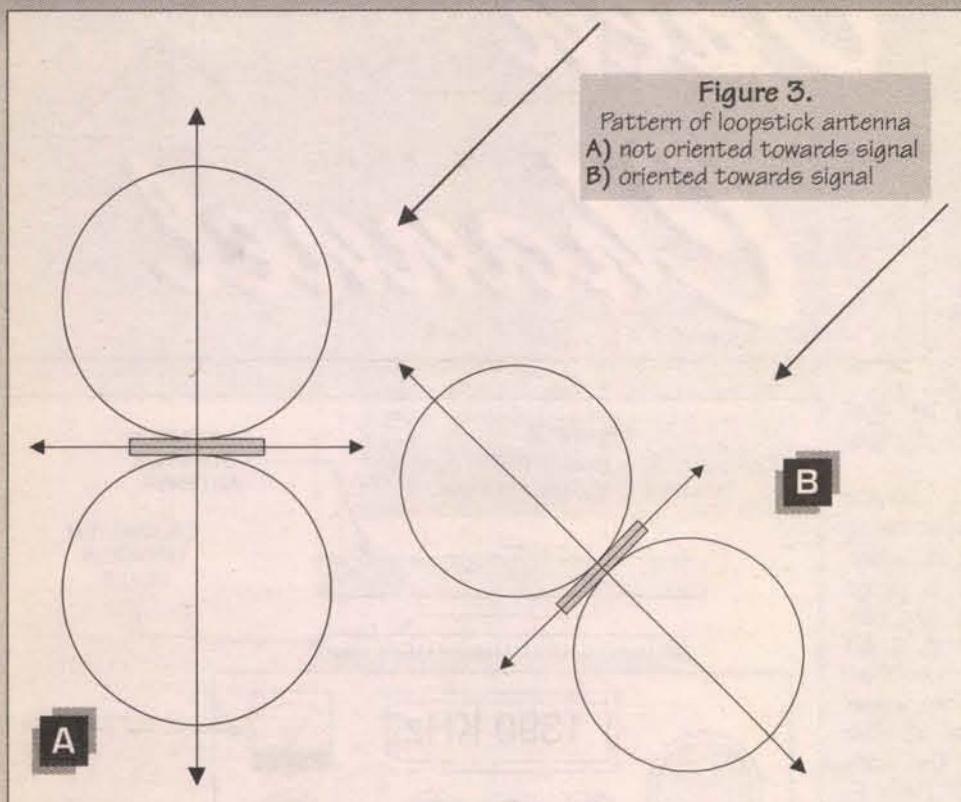
Radio direction finders based on the AM BCB looked a bit like Figure 2. A receiver with an S-meter (which measures signal strength) is equipped with a rotatable ferrite loopstick antenna to form the RDF unit. A degree scale around the perimeter of the antenna base could be oriented towards north so that the bearing could be read.

Loopstick antennas have a "figure-8" reception pattern (Figure 3A) with the maxima parallel to the loopstick rod and the minima off the ends of the rod. When the antenna is pointed at the signal, maximum reception strength is achieved. Unfortunately, the maxima are so broad that it is virtually impossible to find the true point on the compass dial where the signal peaks. The peak is too shallow for that purpose.

Fortunately, the minima are very sharp. You can get a good fix on the direction of the signal by pointing the minima toward the station. This point is found by rotating the antenna until the audio goes to zip or the S-meter dips to a minimum (Figure 3B).

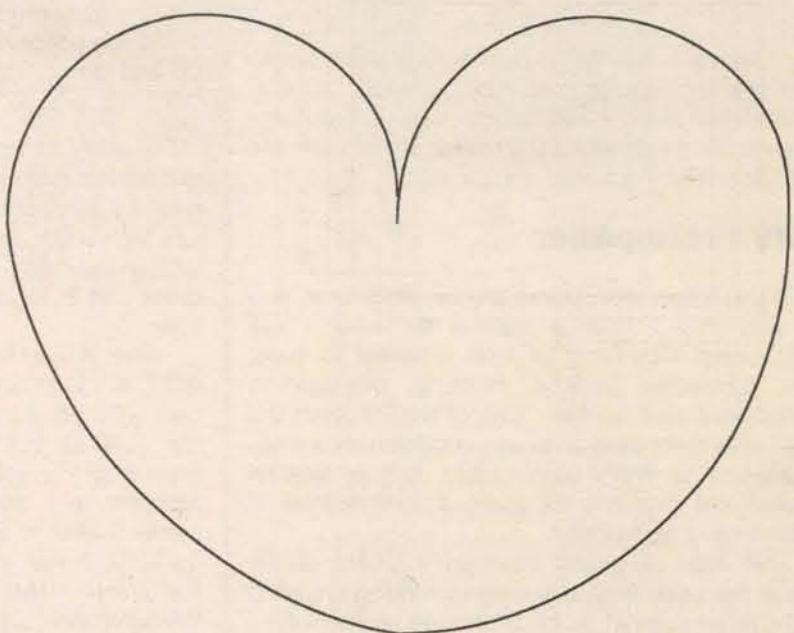
The loopstick is a really neat way to do RDF ... except for one little problem: the darn thing is bidirectional. There are two minima because, after all, the pattern is a figure-8. You will get exactly the same

# Open Channel



**Figure 3.**  
Pattern of loopstick antenna  
A) not oriented towards signal  
B) oriented towards signal

**Figure 5.**  
Cardioid pattern of sense-plus-loopstick antennas.



response from placing either minima in the direction of the station. As a result, the unassisted loopstick can only show you a line along which the radio station is located, but can't tell you which direction it is. Sometimes this doesn't matter.

If you know the station is in a certain city, and that you are generally south of the city, and can distinguish the general direction from other clues, then the line of minimas of the loopstick will refine that information. A compass helps, of course.

Shortly, we will take a look at an impromptu radio direction finder using a portable radio.

The solution to the ambiguity problem is to add a sense antenna to the loopstick (Figure 4). The sense antenna is an omnidirectional vertical whip, and its signal is combined with that of the loopstick in an R-C phasing circuit. When the two patterns are com-

bined, the resultant pattern will resemble Figure 5. This pattern is called a cardioid because of the "heart" shape it exhibits. This pattern has only one null, so it resolves the ambiguity of the loopstick used alone.

## Field Improvisation

Let's suppose you are out in the woods trekking around the habitat of lions, tigers, and bears (plus a rattlesnake or two for good measure). Normally you find your way with a compass, a Geological Survey 7.5-minute topo map, and a Global Positioning System (GPS) receiver. Those little GPS marvels can give you real good latitude and longitude indication. But what happens if it breaks or a bear eats it? The answer to your direction finding problem might be the little portable AM BCB radio (Figure 6) that you brought along for company.

Open the back of the radio and find the loopstick antenna. You will need to know which axis it lays along. In the radio shown in Figure 6, the loopstick is along the top of the radio from left-to-right. In other radios, it is vertical from top-to-bottom. Once you know the direction, you can tune in a known AM station and orient the radio until you find a null. Your compass can give you the bearing. If you know the approximate location of the station, then you can reverse the compass direction from it and mark the line on the topo map. Of course, it's still a bidirectional indication, so all you know is the line along which you are lost.

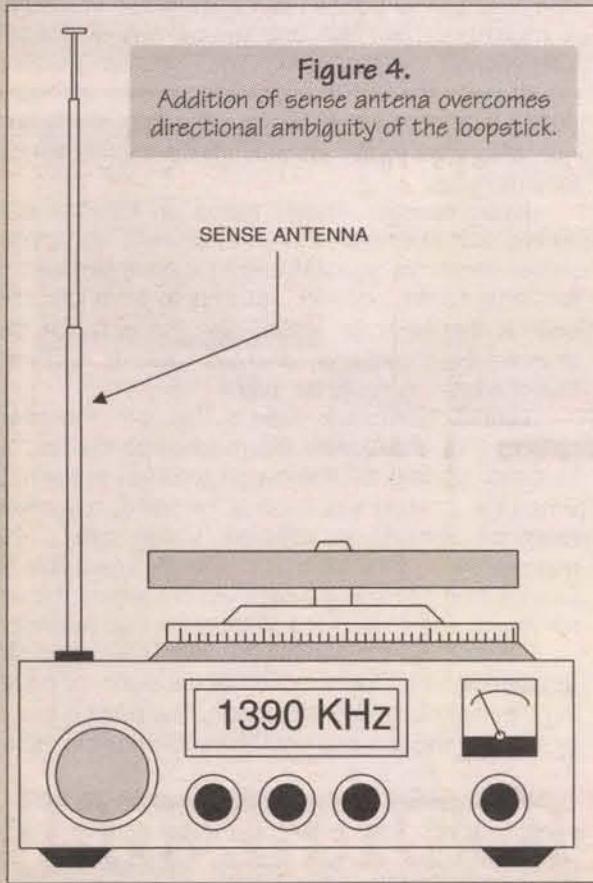
But then you tune into a different station in a different city (or at least wide enough from the line to the other station to make a difference) and take another reading. Your approximate location is where the two lines cross. Take a third, fourth, and fifth reading and you will home in pretty tight. If you were smart enough to plan ahead, you will have selected candidate stations in advance and located their latitude and longitude. Alternatively, you would have bought the topo map that covers their location, as well as where you want to hike ... and from those maps you can

find the latitudes and longitudes of the distant stations.

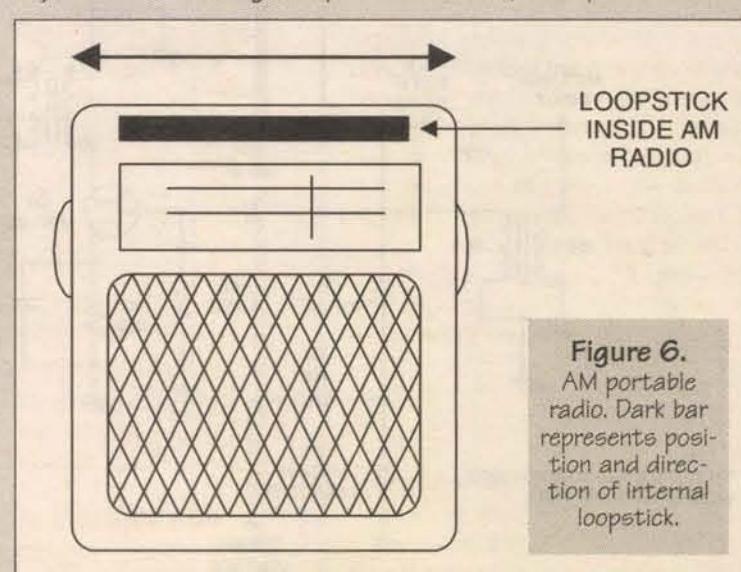
A fellow I met in a class told me of a situation that occurred when he was in Desert Storm. He was part of a communications battalion. They used GPS receivers to find their way. Unfortunately, the Army did not have enough of them for all hands, so many troops had their relatives send them receivers from home. I understand that a lot of Radio Shack, marine, outdoors, and aviation stores basically sold out of stock. That great high-pitched sucking sound was all of the nation's privately sold GPS receivers heading for Saudi Arabia. But Al's group didn't get enough for their troops. At a meeting of the officers and non-comms in a dusty tent, they lamented the lack of high-tech GPS gear. A grizzled old sergeant, who was probably left over from Verdun if not Gettysburg, offered a solution: "Let's do it like we used to ... teach 'em to read a damn map!"

## Regular Loop Antennas

Regular wire loop antennas (Figure 7) are also used for radio direction finding. In fact, in some cases, the regular loop is preferred over the loopstick. The regular loop antenna may be square (as shown), circular, or any other regular "n-gon" (e.g., hexagon), although for practical reasons, the square is easier to

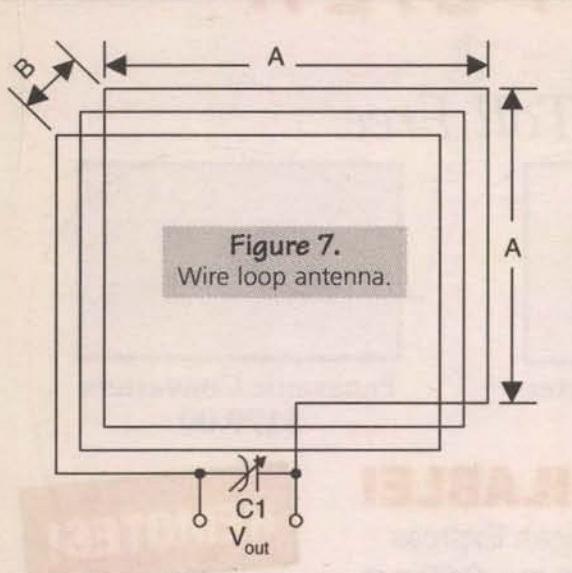


**Figure 4.**  
Addition of sense antenna overcomes directional ambiguity of the loopstick.



**Figure 6.**  
AM portable radio. Dark bar represents position and direction of internal loopstick.

# Open Channel



build. The loop has pretty decent inductance even with only a few turns. One loop I built was 24 inches square ("A" in Figure 7) and had, if I recall correctly, about 10 turns of wire spaced over a one-inch width ("B" in Figure 7). It resonated to the AM BCB with a standard 365-pF "broadcast" variable capacitor. I don't want to go too much into loop antennas here, but if you want more information then see my book *Joe Carr's Receiving Antenna Handbook* (see how shamelessly I plug my stuff??!!).

When you use a regular loop antenna be aware that the antenna has a figure-8 pattern like the loopstick, but it is oriented 90-degrees out of phase with the loopstick antenna. In the regular loop, minima (nulls) are perpendicular to the plane of the loop, while the maxima are off the sides. In Figure 7 the minima are in and out of the page, while the maxima are left and right (or top and bottom).

## Fox Hunting

An activity popular with ham radio operators in the 1960s was Fox Hunting. A fiendishly clever ham would go hide with a mobile or portable transmitter (usually on either 10-meters or 75-meters). The "hunters" would then RDF his brief transmissions and try to locate the transmitter. If you could locate the antenna then you located the station (according to the most common set of rules). Sometimes the "hunt" got a little wild as guys raced each other (a no-no) in the final stretch.

One friend of mine had an interesting experience. He drove a 1949 Plymouth that was painted a hideous dark green with fire engine red hub caps. It looked just plain awful (especially since the paint looked like it was put on with a whisk broom!). He used a Gonet converter linked to the AM BCB receiver installed in the car. The antenna was a wire loop on the end of a broom handle, similar to Figure 8. The antenna was mounted about where you would expect the left-side rear view mirror to be located. He could reach his hand out the window and rotate the antenna while listening for the minima on the receiver. Worked rather well and he won some Fox Hunts.

The Fox Hunts in his area were usually held on Saturday or Sunday morning and, after it was all over, the whole crew would go to a restaurant

for brunch or beer or something. One morning, however, my buddy with the hideous green car was racing down a residential area to be the first to the transmitter. Others were in the area, and the end game was in motion. Unfortunately, a little old lady called the police complaining about a "... nut racing up and down the street in a strange car waving a cross out the window." Breakfast had to wait that morning, I bet.

Some of those Fox Hunting guys were clever. I recall one incident where the guy brought along a wide-range antenna tuner, set up a 3875-KHz transmitter in the bushes alongside a railroad track, and then loaded up the rails as the antenna. It worked, but the signal was ambiguous. It seemed that darn rail radiated for a good long distance. In that case, the "fox" won and the hunt was called after time-out.

Another fellow took a similar tuner and loaded up the chain link fence around a factory site. That fence was several hundred yards on a side, and had a really strange radiation pattern. He was found, but not without a heckuva lot of difficulty.

## Shortwave and AM BCB "Skip" RDF

Radio direction finding is most accurate over relatively short distances. If you can use the ground wave, then all the better (which is what you use during daylight hours for nearly all AM BCB stations). Skip rolls in on the AM BCB after local sundown, so you can hear all manner of stations all up and down the dial. You can RDF distant stations. Some rather interesting sites have turned up when SWL DXers RDFed some of the infamous "numbers stations." Those stations transmit either CW or voice numbers groups, and are believed to be sending messages to spies around the world. RDFing by DXers has located some of these transmitters at, well, "interesting" sites.

Unfortunately, there are some problems with skip RDFing. When we look at propagation drawings of skip in textbooks, we usually see a one-plane view. The curvature of the earth shows, as does the transmitter and receiver site. A "pencil beam" radio signal travels at some angle up the ionosphere, where it is "reflected" (actually, it's a refraction phenomenon, but looks like reflection to an observer on the sur-

face) back to earth. We can tell from the drawing that the angle of incidence equals the angle of reflection, just like they told us in high school science classes. Oops! The real world is not so neat and crisp, however.

In the real world, the wave might encounter a different ionization density along its path of travel and therefore be deflected from its original path. It might return to earth at a location offset from the direction it appears. If we look at the true bearing from the receiver site to the transmitter site, and then note the azimuthal angle of arrival of the signal, we note that something is amiss.

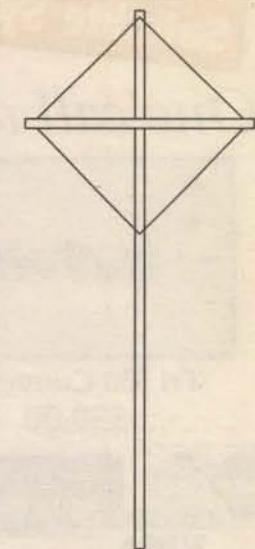
Actual reflection also causes some problems, especially when RDFing a station in the high end of the HF band or the VHF/UHF bands. Radio waves will reflect from geological features such as mountains, as well as man-made structures (e.g., buildings). If the reflection is strong enough it might appear to be the real signal, and cause a severe error in RDFing. Be wary of RDF results when the "skip is in."

## Conclusion

There is a lot more to radio direction finding. In the future, we will look at a few other methods that are more sophisticated than the crude methods shown in this article. Stay tuned ... if you can find me! NV

## Connections ...

I can be reached at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at [carrjj@aol.com](mailto:carrjj@aol.com)



**Figure 8.**

"... waving a cross out the window" antenna.

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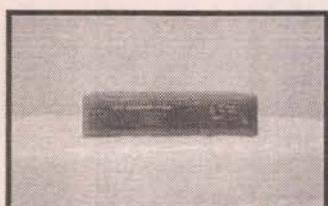
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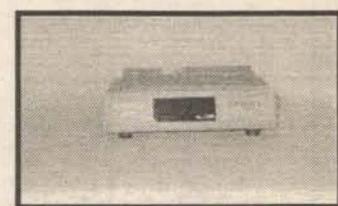
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Continued from page 82

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WI - LA CROSSE - Super Computer Sale. La Crosse Civic Center. Blue Star Productions 612-788-1901. Web: <http://www.supercomputersale.com>

### JANUARY 10

CO - LOVELAND - ARC Superfest. Larimer County Fairgrounds. 700 Railroad Ave. 9am-3pm. 970-352-5304

### JANUARY 11

WI - WAUKESHA - ARRL Hamfest. Phil Gural W9NAW, 414-425-3649

### JANUARY 16-17-18

MN - SHAKOPEE - Super Computer Sale. Canterbury Park. 1100 Canterbury Rd. Blue Star Productions 612-788-1901. Web: <http://www.supercomputersale.com>

### JANUARY 17

LA - HAMMOND - Hamfest. Southeastern Louisiana Jack Stang N5XVJ. 504-542-7605.

MO - ST. JOSEPH - Hamfest. Ramada Inn. 9am-4pm. Jean Pearson KC0GB, PO Box 8547, St. Joseph, MO 64508

### JANUARY 18

FL - ST. PETERSBURG - Hamfest. Jean Endicott KC4KZU. 813-525-5178

NY - YONKERS - Flea Market. Lincoln High School. Kneeland Ave. 9am-3pm. Otto Supliski WB2SLQ,

914-969-1053

VA - RICHMOND - ARRL Hamfest. Craig Spain KE4CIT, 804-526-9838. E-Mail: [frostfest@rats.net](mailto:frostfest@rats.net) Web: <http://www.frostfest.rats.net>

### JANUARY 23-24-25

KS - WICHITA - Super Computer Sale. Century 2 Conv. Ctr. 225 W. Douglas. Blue Star Productions 612-788-1901. Web: <http://www.supercomputer.sale.com>

### JANUARY 24

MO - ST. CHARLES - Hamfest. James E. Welby WB0ZJW. 6059 Sutherland, St. Louis, MO 63109-2247

### JANUARY 25

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

MD - O'DENTON - ARRL Hamfest. Odenton Vol. Fire Dept. Hall, 1425 Annapolis Rd. Bill Ziegler KA6TYY. 410-987-2384. E-Mail: [ka6tyy@juno.com](mailto:ka6tyy@juno.com)

OH - DOVER - ARRL Hamfest. OH Nat'l Guard Armory, 2800 No. Wooster Ave. 8am-1pm. Howard Blind KD8KF. 330-364-5258

TN - GALLATIN - Hamfest & Computer Show. Gallatin Civic Center. 8am-2pm. TN Valley Amateur Radio Network. Bill Ferrell N4SSB, 615-451-5992

### JANUARY 30-31-FEBRUARY 1

WI - MADISON - Super Computer Sale. Dane Co. Expo Center. 1881 Expo Hall E. Blue Star Productions. 612-788-1901. Web: <http://www.supercomputersale.com>

### JANUARY 31

AL - GREENVILLE - Hamfest. Bob W4MPQ. E-Mail: [w4mpq@alaweb.com](mailto:w4mpq@alaweb.com)

### JANUARY 31-FEBRUARY 1

MO - ST. CHARLES - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066. E-Mail: [computershowschicago@mci.com](mailto:computershowschicago@mci.com)

## FEBRUARY 1998

### FEBRUARY 6-7-8

IL - PEORIA - Super Computer Sale. Peoria Civic Center. 201 S.W. Jefferson St. Blue Star Productions 612-788-1901. Web: <http://www.supercomputer.sale.com>

### FEBRUARY 7

SC - NORTH CHARLESTON - APRL Hamfest. Jenny Myers WA4NGV, 803-747-2324

### FEBRUARY 7-8

FL - MIAMI - Hamboree. Dade Co. Fair & Expo Center, SW 112th Ave. & Coral Way. Evelyn 305-642-4139. E-Mail: [edg@elink.net](mailto:edg@elink.net) Web: <http://hamboree.org>

### FEBRUARY 13-14-15

IN - INDIANAPOLIS - IN Convention RCA Dome. 100 S. Capital. Blue Star Productions 612-788-1901. Web: <http://www.supercomputersale.com>

### FEBRUARY 13-14

FL - ORLANDO - Northern Florida Section Convention. John P. Lenkerd W4DNU. 407-645-2026

### FEBRUARY 14

MN - BLAINE - ARRL Hamfest. Susan Baker NOJND, 612-537-1722

### FEBRUARY 20-21-22

KS - KANSAS CITY - Super Computer Sale. Overland Park Trade Ctr. 6800 W. 115th St. Blue Star Productions. 612-788-1901. Web: <http://www.supercomputersale.com>

### FEBRUARY 21

NC - ELKIN - ARRL Hamfest. Jimmy Holbrook KB4GKI, 910-957-3820. E-Mail: [jholbro363@aol.com](mailto:jholbro363@aol.com)

### FEBRUARY 22

OH - CINCINNATI - Great Lakes Div. Convention. Bill Tittle KA8LAY. 513-661-1805

### FEBRUARY 22

OH - CUYAHOGA FALLS - ARRL Hamfest. Dan Adkinson KC8CFJ. 330-923-9045

PA - PITTSBURGH - Hamfest. Steve Lane N3RNY, 412-341-1043. E-Mail: [slane@sg1.net](mailto:slane@sg1.net)

### FEBRUARY 27-28-29

CO - DENVER - Super Computer Sale. National Western Complex. 4655 Humboldt St. Blue Star Productions 612-788-1901. Web: <http://www.supercomputersale.com>

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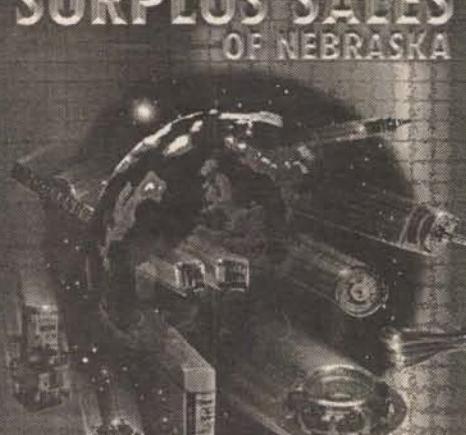
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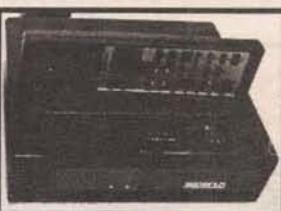


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#### MARCH 8

**IN - INDIANAPOLIS** - Hamfest. Brian Elliott N9JPK. 317-342-7236. E-Mail: bellotti@surf-ici.com

**NY - LINDENHIRST** - ARRL Hamfest. Walter Wenzel KA2RGI. 516-457-0218. E-Mail: Tom Carrubba: ka2d@li.net Web: http://www.li.net/~tomcar/hamfest.htm

**WI - WAUKESHA** - Hamfest. Mary J. Adams KB9IFF. 414-358-1003. E-Mail: mjadams@execpc.com

#### MARCH 13-14-15

**NE - OMAHA** - Super Computer Sale. Omaha Civic Auditorium. 1804 Capital Ave. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

#### MARCH 14

**FL - SEBRING** - ARRL Hamfest. Dennis Koranda KF4JTM. 941-382-9560. E-Mail: kf40strato.net

#### MARCH 15

**OH - MAUMEE** - ARRL Hamfest. Brenda Kukowski KB8IUP. 419-866-5928

#### MARCH 20-21-22

**WI - WEST ALLIS** - Super Computer Sale. WI State Fairgrounds. 8100 W. Greenfield Ave. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

#### MARCH 22

**NC - KINSTON** - ARRL Hamfest. Doug Burt W4OFO. 919-524-5724

#### MARCH 28

**KY - ELIZABETHTOWN** - ARRL Hamfest. Harold Bennett AF4AC. 502-351-9599. E-Mail: hbennett@bbtel.com

**OR - EUGENE** - ARRL Hamfest. John Brambora KB7SXS. 541-747-2898

#### MARCH 28-29

**MD - TIMONIUM** - Maryland State Convention.

William Dobson N3WD. 410-HAM-FEST. E-Mail: gdhc@concentric.net Web: http://www.concentric.net/~gdhc

#### MARCH 29

**CA - SANTA ANA** - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

### APRIL 1998

#### APRIL 4

**NC - MORGANTON** - Hamfest. Thomas Taylor KC4QPR. 704-433-6205. E-Mail: kc4qpr@vistatech.net

**PA - FREDERICKSBURG** - ARRL Hamfest. Paul Felt WB3HEC. 717-566-2606

**WA - VANCOUVER** - ARRL Hamfest. Luther Brisky KC7KVL. 360-896-8909

#### APRIL 5

**IA - DELOIT** - Hamfest. John Amador KD6MXL. 712-748-8162. E-Mail: johnmxl@netins.net Web: http://www.netins.net/showcase/johnmxl/deloit98.html

**NC - RALEIGH** - North Carolina State Convention. Wilbur Goss WD4RDT. 919-266-9335

**WI - MADISON** - ARRL Hamfest. Jeremy Charles N9VHT. 608-245-8890

#### APRIL 10-11

**MS - TUPELO** - ARRL Hamfest. Jack Ellis KI5QV. 601-842-7255

#### APRIL 18

**MO - JOPLIN** - ARRL Hamfest. Andy Gabbert KA0TUD. 417-673-8371. E-Mail: agabbertka0tud@hotmail.com

#### APRIL 19

**MA - CAMBRIDGE** - Hamfest. Steve Finberg W1GSL. Nick Altenbernd KA1MQX. 617-253-3776

#### APRIL 24-25

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**IA - DES MOINES** - ARRL Hamfest. Ron Hobbs NOXWI. 515-255-4020

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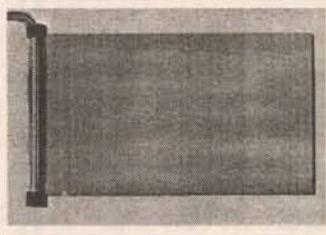
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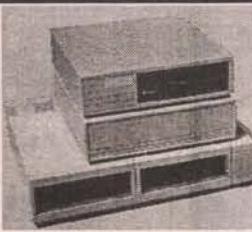
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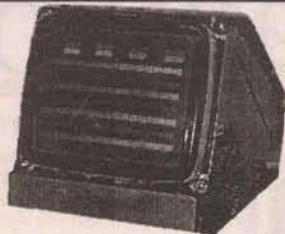


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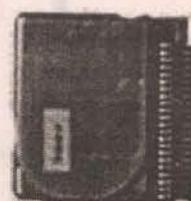
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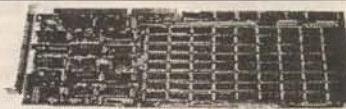


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# RESOURCE BIN

number seventy

## Exploring PostScript PIC Flutterwumpers

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I'm now in the process of setting up my new *Guru's Lair* web site you will find at (where else?) [www.tinaja.com](http://www.tinaja.com) — This is the place you go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns.

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### PostScript PIC Flutterwumpers

For quite a long time now, I've been really enthused by *Adobe's PostScript computer language*. I'll routinely use PostScript well beyond its printing and graphics capabilities. What I find really exciting is that with some brand new happenings, PostScript can now expand into robotics.

Specifically by getting low-end PIC microprocessors to speak PostScript!

PostScript and PICs working with each other might be a killer combo for ultra low-cost robotic apps. Especially with such things as re-using existing artwork, interfacing popular design programs, selecting fancy fonts, doing microsizing, tool path corrections, or exotic coordinate transformations.

And most of it is simple stuff that you can easily explore all by yourself. Opening up some mind-blowing new opportunities for you.

Others have been quietly extending and greatly improving on PostScript all along. PostScript now has total web friendliness, transparent video titling apps, document scan conversion, catalog indexing,

interactive forms, internal font provisions, drivers that print anywhere, disability aides, and great heaping bunches more.

But the real biggie is that PostScript itself has recently gotten ridiculously easier to use and lots more fun for you to play with.

### Getting Started with PostScript as Language

The easiest way to start exploring PostScript is by using a host-

### NEXT MONTH: Don takes another look into secrets of web-based research.

*based interpreter*. This is simply a program you run on your PC. You send the interpreter PostScript language code, and the interpreter carries out those commands for you.

Usually with nothing but a simple drag-and-drop. There are normally three possible results from your PostScript code:

**(A) You could generate a file that can be used to print or image or webify or CD-ROMify a graphic picture.** Such pictures are fully device-independent, superbly high quality, and an industry-standard mix of actual images, text, line art, and fancy fonts.

**(B) You can generate a simple log file** that quickly gives you important answers directly on your screen.

**(C) You can write an output data file to disk.** Such an output file can have virtually any format you want it to. In most any language!

These output files can then be used for anything from taking over control of a computer to running a hot tub.

PostScript can similarly get taught to read and act upon just about any input file format you care to. Details are found in

### SIXCLICK.HTML

There are two very popular host-based PostScript interpreters. The first and older is that freebie *GhostScript* shareware from *Aladdin Systems*. The second is the *Acrobat Distiller* that is part of the commercial *Adobe Acrobat* package. By using a student discount, *Distiller* is available for under \$55.00.

Get Version 3.01 or higher.

Do not let the name mislead you. *Acrobat Distiller* is really a full-blown PostScript language interpreter that is easily and quickly applied for totally general-purpose computing.

When combined with a companion *Acrobat Exchange* viewer, you'll get everything important that genuine Display PostScript offers. Especially the ability to have source code and fast updating graphic results side-by-side on your screen at once.

*Distiller* also acts as "somewhat" of a compiler. In that it automatically reduces PostScript code into the bare minimum "just the facts ma'am" and fast running compressed .PDF format. For instance, an input PostScript proc may include very elaborate fill justify calculations or math-intensive plots. The output PDF format simply shows where to mark the pages or what final numeric data values to output.

Which PostScript interpreter is for you? My own preference is to always use the *Acrobat Distiller*. *Distiller* is faster, way easier to run, much better supported, is fully up-to-date, has only official bugs, and gives you more attractive final results. On the other hand, *GhostScript* is free and gives you better error reporting.

### Two Examples

Let's look at two examples to get you started off using PostScript as a programming language. Assume you want to find the sine of 60 degrees. Punch this code into your favorite editor or word processor ...

```
%!
% find sine of 60 degrees
60 sin ==
```

... and then save it as either a .PS file or as an ordinary .TXT text file. Drag and drop this file into *Distiller* or *GhostScript*, and an output value of 0.866025 should promptly appear in the log window on screen.

We can see several things here. A PostScript file consists of an ordinary text file containing more or less plain English words and numbers. Other more compact file formats are also available for

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# RESOURCE BIN

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advanced users.

At a minimum, your file *must* start off with a "%!". To be formally legal, special *document structuring convention* comments are also strongly suggested for use in fancier projects.

Any line which starts with a "%" is treated as a comment. Thus, only the third line of your program actually does anything useful. This line places a numeric value of 60 onto an internal *stack*. A *sin* command then obeys the rule "take the value in degrees on the top of the stack, find its trigonometric sine, and replace the top stack value with this calculated result."

That odd "==" is shorthand for "intelligently print the top stack value to your log file."

Should the PostScript program also produce some graphic or printable output, you simply click on Exchange to view it on the screen. Your round trip edit-interpret-view time is typically well under 10 seconds and can be done in as little as six mouse clicks.

In PostScript, we have a powerful and quite modern general-purpose language that is *interpretive* (you tell it what to do ahead of time); is *stack-oriented* (everything goes on or off one or more stacks); *Polish structured* (you give it some values first, followed by your needed instructions that act on those values); is quite *object-oriented* (individual procs can be manipulated with uniformly predictable results); *threaded* (any command can call any other); *weakly typed* (most any data structure can get converted to any other); *re-entrant* (commands can call themselves); *dictionary intelligent* (the grouped key-value pairs play a big role); *re-definable* (you can add new commands or procs and change any existing ones); and *device-independent* (the same code runs on any host and controls any PostScript device of any quality level).

Let's look at a second and fancier app. Finding out who accesses your website when is a big deal these days. There's lots of fancy programs (such as *WebTrends*) which can give you all sorts of exotic plots and graphs. But only with horrendous use of memory and disk space.

PostScript can easily read and then interpret web log files. A no-cost 5K PostScript file can trivially

extract log file data that the big programs may miss. Such as analyzing the loyalty of repeat visitors. Or maybe tracking the popularity of a brand new file as it moves up through the ranks.

The site analysis code is a tad too long to show you here. But you can grab examples of these programs as *WEBSITAN1.PS* or *WEBLOGU2.PS* off my [www.tina.ja.com/psutils.html](http://www.tina.ja.com/psutils.html) — There's extensive documentation inside either file. All you have to do is rename your target and destination files for your own use.

There are dozens more PostScript as language examples where these two came from. Recapping, PostScript is now really fast, fun, and easy to use. You first create a text file, then drag and drop it into Distiller, and then you optionally view it with Exchange reading any file format, or creating any new file format, or generating graphics.

### Robotic Flutterwumpers

What does all this have to do with robots? Let's backtrack a tad. I like to call a *flutterwumper* anything robotic that moves and either chomps or spits.

Printed circuit drills, sign routers, engravers, silkscreen cutters, Santa Claus set-ups, or animation stands are typical examples.

The basics of flutterwumpers are shown in *FLUTWUMP.PDF*.

Let's say you decide to build a custom 2-1/2 D flutterwumper. One that has independent X and Y motions in small steps, but only allows a gross "tool up" or "tool down" in your Z direction. Let us further assume that fonts play an important role and that you want to access large libraries of existing symbol icons or whatever, as well as use standard CAD, *Mathlab*, or *Illustrator* design software.

A PIC or two is the obvious choice to handle all your low-level custom flutterwumper controllers. But how on earth can you get it to do the fancy stuff while still remaining both low in cost and elegantly simple?

Your secret lies in the interactions between ...

### Flutfiles and PICs

For some strange reason, I

seem to be having some difficulties burning a full PostScript version 2019 interpreter into the 12C508 baby PIC. Mostly, if I did so, it just wouldn't be very fair to Motorola or Intel.

Let's instead partition the problem. Let host PostScript software do the sort of things it is really good at. Let a small and low-cost PIC do all your flutterwumper stepper controlling. And let's dream up some way that PostScript can talk to PICs and that PICs can talk back to PostScript.

We have two obvious choices here that certainly should work. *Hewlett Packard* has long had its HPGL plotter language. And there's the *Gerber File Format* used on fancier photoplotters. Either of these will work just fine. But they might end up gross overkill for a low-cost flutterwumper. And either will tie up a substantial part of your PIC's resources.

Instead, let's get elegantly simple. Let's create a new ultra simple meta language. One that's PIC optimized on one end and PostScript optimized on the other.

I'll call this one a *flutfile*.

We will limit our new language to ordinary printing ASCII characters and carriage returns in a plain old textfile. We will use the rule of *one character per action*. Now, this might seem slow and cumbersome, but you usually have more than enough time available on any mechanical motion flutterwumper. And the economics are stunning.

On a 2-1/2 D flutterwumper, there will only be eight possible horizontal actions. You can go one step positive or negative in directions of X, Y, or both at the same time.

So, let the ASCII numeral 0 be east; 1 be northeast; 2 be north. And so on around to a 7 at southeast. To round out your commands, add a U for up, a D for down, and an H for home. And maybe a few initializing, debug, and repeat commands.

All your PIC has to do is receive a dozen or so serial ASCII characters and then act upon them. For instance, command "0" causes one full step in the positive X direction. Command "1" moves both the X and Y steppers one full step. For max smoothness, your individual partial steps between X and Y can get interleaved. Command "2" moves Y only, and so on.

Now all that PostScript has to do is accept programming commands and generate a meta file which is a lot easier than it sounds.

I've got lots of ready-to-run code for you.

Let me briefly outline the PS to flutfile process: The Distiller normally reduces all wanted motions to *moveto* positioning, *lineto* straight line paths, *curveto* curved path generation, and *closepath* operators. We then eliminate any *curveto*'s with use of PostScript's *flattenpath* command.

Since any command in PostScript can be re-defined at any time for any reason, your remaining stock *moveto* and *lineto* commands are intercepted and replaced with your custom code. Among other tasks, this custom code does vector-to-step conversion at the exact resolution needed by your PIC and saves it in a flutfile format.

Detailed flutfile conversion tutorial examples appear in *POST-FLUT.PDF*, *FLUTOOLS.PS*, *FLUT-DEMO.PDF*, and *VECTSTEP.PDF* on my website.

Included are specific programming details on how you handle boxes, circles, and fancy font characters. You can use these as preliminary test files for your own PIC design.

### How it Works

Here's a summary of how to bring PostScript to any PIC robotic: Install Acrobat Distiller and Exchange 3.01 or better on your host PC. Find suitable project material from CAD programs that provide a PostScript output, from *Illustrator*, or by fun writing your own raw PostScript like I always do.

Use Distiller and a custom software module to convert your pattern files into flutfiles, the simple step-by-step commands that a low-end PIC can understand and easily deal with. Such magic tricks as tool path adjusting or fancy coordinate transforms could also be included in this step.

Save your flutfile as an ordinary textfile. Gather up this flutfile with a comm program or whatever and send it to your PIC. Obviously, the flutfiles can be saved for reuse, broken up into module libraries, get web distributed, or combined into projects.

Suitable handshaking takes care of machine busy times. This two-step process thus brings PostScript to your PICs simply, cheaply, and elegantly.

### For More Help

That Adobe "red" book (*PostScript Reference Manual*) and their Adobe "blue" book (*the PostScript Tutorial & Cookbook*) are your standard starting points to learn and love PostScript. These

could get combined with my PostScript Beginner Stuff course-work or the Whole Works package that lets you get into PostScript all at once and really big-time. Refer to my nearby Synergetics ad for details.

Lots more info on exactly how to bring PostScript to PICs appears in the previously noted files on my website. For bunches more background, also check the PostScript, Acrobat, PIC, and Flutterwumper library shelves found at [www.tinaja.com](http://www.tinaja.com) — More on the PICs themselves from manufacturer Microchip Technology, from Parallax, and from Scott Edwards Electronics.

Some 600+ annotated hot links to useful PIC sites appear at [www.tinaja.com/pic500.html](http://www.tinaja.com/pic500.html) and also in [www.tinaja.com/picwb01.html](http://www.tinaja.com/picwb01.html) — More on those briefly mentioned PostScript transparent video apps by way of [www.videonics.com](http://www.videonics.com) — and, of course, lots more on PostScript and Acrobat at their [www.adobe.com](http://www.adobe.com)

More technical help, InfoPacks, full consulting, custom programming, or development is available by E-Mailing me through [don@tinaja.com](mailto:don@tinaja.com)

### This Month's Contest

For our contest this month, just tell me what you would do with your PostScript speaking PIC. Especially one of the new minidip baby PICs.

There should be a largish pile of my new *Incredible Secret Money Machine II* books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja* quest for two that will go to the very best of all.

Send all your written entries to me here at Synergetics, rather than to Nuts & Volts editorial. NV

**M**icrocomputer pioneer and guru Don Lancaster is the author of 33 books and countless tech articles. Don maintains his no-charge US tech helpline found at (520) 428-4073, besides offering all of his own books, reprints, and consulting services. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time.

Don is in the process of setting up his Guru's Lair at <http://www.tinaja.com>

Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to his US Internet address of [don@tinaja.com](mailto:don@tinaja.com)

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### reader feedback

Continued from page 5

Dear Nuts & Volts:

I found the article "Juju! Disk Fiksing!" Sept. '97 somewhat elementary. I'm very experienced in having floppy disk problems. It's more than just cleaning the disk to get it to work, you need to move the bad sectors.

This is my big secret on how to retrieve data from a corrupt disk:

The first thing I do when a disk is not reading is run Norton Disk Doctor (Win 95), or fsck (Linux), or some program similar to this (not clean the disk).

When you diagnose the floppy disk with Norton, it will check each sector of the disk until it gets to a bad sector. NDD (Norton Disk Doctor) will

usually attempt to move the data on this bad sector to a clean sector.

The disk will work if you have space for the bad sector. But what if you don't have room on the disk to move the bad sector because you made a ZIP or ARJ disk set? You can't delete the file on the disk because there is only one file.

Run NDD, and take note when NDD says where the bad sectors are in the disk.

You need to find a program that will split a file into two and run this program on the ZIP or ARJ file in the disk. I usually use gnu split from Linux, but recompiled it for DOS.

Try to split the file with all the bad sectors on one file. Now copy the file from the disk that supposedly does not have the bad sectors to your hard drive. Now delete the file that you just

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copied from the disk and run NDD. You will now have free space to move those bad sectors. Once the second part of the file is readable, you can copy it to your hard drive and recombine it with the other half of the file. Now copy the file to a brand new disk. The new disk is just like your old disk except that it's not corrupt.

AGENT

Dear Nuts & Volts:

The Sept. '97 issue was great. I really liked the articles about how to fix floppies that went bad, data encryption, Windows 95 advanced techniques, how to use Stamp applications written for the common man, and the Resource Bin. The rest was pretty good too. You're the best!

William Keene  
Rawlins, WY

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# ELECTRONICS

## Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware and software. This column doesn't replace the Tech Forum that you've grown to love and support. Instead, it will supplement it, so feel free to participate as always with your questions and answers. You can reach me on America Online at TJBTERS, on the Internet at TJBTERS@aol.com or by snail mail at Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.

### What's Up:

Where to buy servos and solar panels. More on taking your modem on the road; includes a phone line tester circuit. A discussion of monster cables for audiophiles, and digging for earth worms without a shovel. How to build a 9-pin to 15-pin monitor adapter, and how to plug 30-pin SIMMs into a 72-pin slot, plus more talk about free telephone power.

### Seeking Servos

**Q.** I saw your Simple Servo Controller in the Aug. '97 issue, and would like to experiment with these fascinating devices. However, I'm unable to find where to buy servo motors, not even in any of the electronic parts magazines. So where do you find them?

Robert J. Covert  
Crescent City, CA

**A.** You can buy them at just about any hobby shop that deals in radio-controlled (RC) model planes, boats, or cars. The prices range from \$10.00 to \$65.00, depending on the size and torque. You can buy them via mail order, too. Tower Hobbies (217-398-3636; <http://www.towerhobbies.com/index.html>) stocks a large selection of servo motors at the best prices in town. Servos are also used extensively in robotics to move limbs and steer the monsters. One of our advertisers, Lynxmotion (309-382-1816; <http://www.lynxmotion.com>), sells the popular Hitec HS-300 for just \$15.00 each, or \$80.00 for a six pack. Have fun!

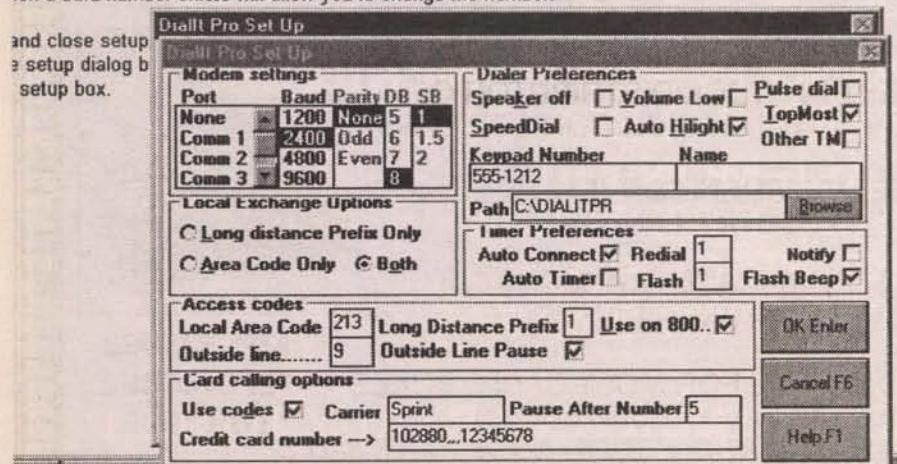
### Road Warrior Needs Dial Tone

**Q.** Your explanation in the May '97 issue on dialing from a motel was well done, but I have two additional questions on the subject. First, how can I use my long distance calling card, which requires responding to prompts at specific times. Second, I've seen devices which are supposed to protect against modem damage if the modem is connected to the wrong kind of phone system. How do the devices work, are they needed, and how can I identify which phone systems might cause damage? Can I construct such a device?

Mike Roe  
via Internet

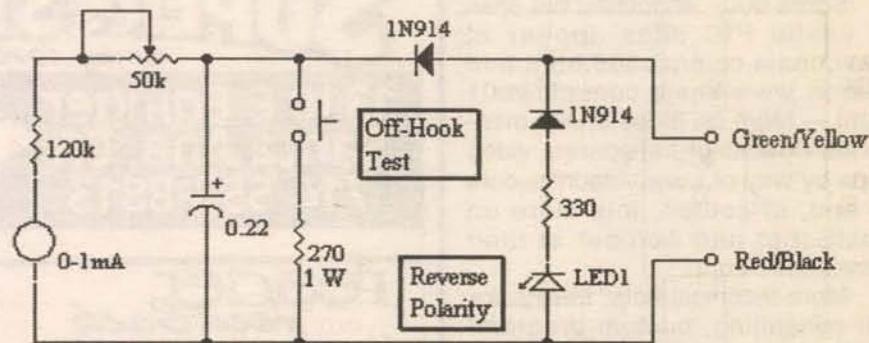
**A.** That's five questions, Mike, but who's counting? In response to your first question, about your long-distance calling card, I'd use a software dialer that supports calling cards, like Dial-It Pro. You can find this program on our Web site (<http://www.nutsvolts.com>) under the title DIAL.ZIP.

Then a card number exists will allow you to change the number.



This shareware program lets you dial the phone from virtually any

Windows application. In your case, what you want to do is enter a string of numbers and pauses in an order that will access your service's dial tone. (Pauses are created by inserting commas between digits; each comma represents a two-second delay.) Once you hear the dial tone, simply run your communications software as usual (have it ready first, or you'll lose the dial tone) and let it do its thing with the modem. To run Dial-It, you need to have a file called VBRUN300.DLL (included in DIAL.ZIP) present in the C:\WINDOWS directory. In response to your next series of questions, phone line testers abound in retail outlets like Radio Shack and larger hardware stores. Unfortunately, most are simple LED devices that test only for correct polarity. Here's a circuit that actually lets you see what the voltages on the phone line look like before you plug in your modem.



Basically, this is an analog voltmeter that monitors both the line and ringer voltages. It identifies the line polarity, too, via the steering diodes. When the polarity is reversed, the LED lights and the meter registers nothing. When connected to a line of the correct polarity, the meter should read 48 to 52 volts. Pressing the Off-Hook Test button should drop the line voltage to 10 volts. If not, don't plug in your modem. When the phone rings, the diodes rectify the AC voltage, which should read between 40 and 90 volts, and the LED flashes. The circuit is built around a 0-1 mA analog meter, such as the Radio Shack 270-1754. In fact, this meter is the perfect choice because the scale reads from 0 to 15, which can be calibrated to represent 0 to 150 volts by adjusting the 50K pot, and the price is right. There are several ways to calibrate the meter. The best way is to measure the voltage of a good phone line with a DMM and adjust the meter to read the same value.

### 9-Pin To 15-Pin SVGA Adapter

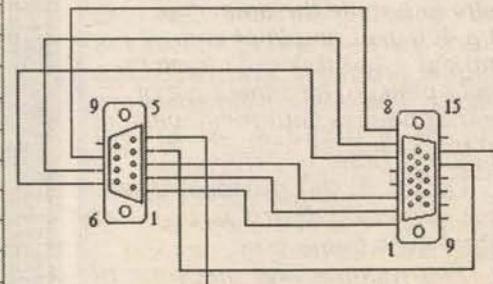
**Q.** I have an AST Vision 4i monitor that has no video cable. It's SVGA, but the port on the back is 9 pin, not the standard 15 pins. I could make a cable if I knew the pinouts but I have no documentation. Can you help?

John Covington  
via Internet

**A.** I've answered this question so many times that's it's starting to become a staple. So I'm gonna post the schematic on our Web site under the name SVGA9PIN.BMP. This file is in BMP format that you can view with Windows Paint. Meanwhile, here's what you're looking for.

15-Pin	9-Pin	Description
1	1	Red gun
2	2	Green gun
3	3	Blue gun
4	--	Monitor ID bit 2
5	--	no connection
6	6	GND (red return)
7	7	GND (green return)
8	8	GND (blue return)
9	--	no connection
10	--	GND
11	--	Monitor ID bit 0
12	--	Monitor ID bit 1
13	4	Horizontal sync
14	5	Vertical sync
15	--	no connection

9-PIN      15-PIN



Oh yeah, don't forget to flip the monitor's MODE switch from TTL to ana-

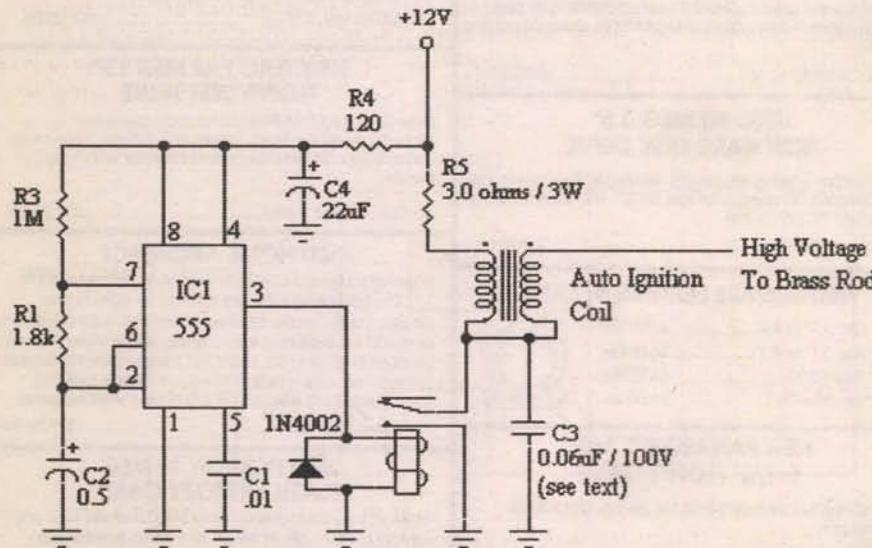
log when using it with an SVGA card.

### Worm Chaser

**Q.** My question is about the "Battery-Powered Fence Charger" in the Aug. '97 issue. I may be dumb, but I can't locate capacitor C1 in the drawing. Anyway, I built the device and it doesn't work. Is it because C1 is missing? I would like to use the zapper to collect fishing worms by chasing the critters out of the ground with a high-voltage jolt. Would one brass rod in the ground work or do I need two of them?

Terry Crowe  
Woodruff, SC

**A.** Well, you're not dumb or blind. C1, the 0.01 uF capacitor coming off pin 5, isn't labeled, but the circuit will work without it. The text reference to C1 is actually talking about C2 (0.5 uF). My guess is that Q1 has died. Since you're going to be drawing a lot of current from this coil to chase worms, I'd replace Q1 with a relay, as shown below.



If it still doesn't work, I suspect that C3 isn't matched to the coil or it's defective. In answer to your second question, yes you have to have two rods in the ground. Although I've never tried this, I hear it works quite well — but only if the soil is moist, and not too wet. It doesn't work in dry earth, so you'll have to experiment with moisture and the rod spacing. I hope you catch a big one!

### Monster Cables

**Q.** Every part of my stereo has been upgraded — except the speaker wires. They're still the thin plastic wires that came with the original system. I'm ready to take the final plunge, but I'm confused about this last upgrade. Can you explain the difference between monster cables and Litz wire, and which I should choose?

Sam Goldmann  
Sylmar, CA

**A.** Some purist will tell you that the speaker cable can make or break a stereo system. That's rubbish. It's just another way to pick your pocket. Don't get me wrong, you need good heavy-duty speaker wire to handle the amperage that a 400-watt amplifier can pump out — but it doesn't have to be gold plated! The same type of wire that powers your microwave oven works just as well. But to answer your question, the difference between monster cables and Litz wire is the way the wire is constructed. Contrary to common belief, electricity doesn't flow through a conductor. Instead it flows on the surface of the wire. The amount of current penetration depends on the frequency. At 60 Hz, 90% of the current flows through 10% of the outside layer of a solid wire. The core of the

wire sees virtually no current. This is why stranded wire is preferred to solid — greater surface area! Litz wire differs from regular stranded wire in that each strand is insulated to maximize the surface area. When to use Litz and when not to depends on the frequency. The skin effect (electrons flowing on the surface of the conductor) doesn't really make a difference until the frequency exceeds 1 MHz. As the frequency goes higher, the more the skin effect, which is why microwave conductors are hollow lengths of tubing called waveguides. Starting to get the message? (This is a very superficial discussion — only skin deep. For more details you need to understand wave theory, but I'll save that for another column.) So, if you're wiring a subwoofer, forget Litz and the gold plate. What you need is heavy-duty stranded wire, like lamp cord. Okay, audiophiles, I'm ready for your flack. My only qualification is that you have to prove I'm wrong with real numbers, not your subjective "Golden Ears."

(Continued on page 109)

### Reader's Tip: Hard Disk Recovery Routine

In the Sept. '97 issue, you responded to a reader with a hard disk that had frozen out FDISK. The cause of the problem is that FDISK cannot recognize the format of the disk, and therefore can't operate on the Master Partition Table. You suggested using a Seagate utility that does a medium-level format. I've written a simple Debug routine (just five instructions) to solve the same symptom that your readers might find useful. This routine wipes out Sector 1 (writes all zeros), Cylinder 0, Head 0, which makes the drive look like an unformatted drive to FDISK. To run this routine, boot the system from a floppy that contains DEBUG, FDISK, and FORMAT. At the DOS prompt, type "debug" and enter the following sequence (enter the capitals only, not the lower-case comments). Press the Enter key at the end of each line.

<pre> A MOV AX,0301 MOV BX,0020 MOV CX,0001 MOV DX,0080 INT 13 [enter] G=100 10E </pre>	<pre> ;debug assemble command ;write one sector (512 bytes) ;data address ds:0020 (all zeros) ;set cyl 0 and sect 1 ;head 0 and physical drive 0 (0081 sets drive 1) ;execute interrupt 13 ;assemble and return to debug prompt ;go do it </pre>
---	--

**WARNING:** This program will wipe out ALL data on the hard drive — data will now be forever lost and totally unrecoverable. It doesn't ask if you really want to do it — it just happens. So be absolutely sure this is what you want before you press that final Enter. I've recovered drives from used and surplus machines using this routine, even though I was told the drives couldn't be formatted. I hope this trick helps someone else, too.

Don Pomeroy  
via Internet

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270Meg 3.5" Quantum SCSI M# Pro 270S ..... \$69.95 Ea.

## NEW 16-BIT 256K ISA VGA CARDS

Designed for the PC-XT/PC-AT & compatibles, this is a basic low cost VGA video card. 256K DRAM with chips & technology 82C451. Full backward compatibility with EGA, CGA, MDA, and Hercules modes. Card type: ISA 16-bit.

Model # VGA 300 (VGA Card) ..... \$19.95 Ea.

## FIRST AID 95 BY CYBERMEDIA

New retail boxed CD-ROM version for Windows 95 and 3.1. Fixes Windows problems automatically. System Req: IBM Compatible 386 or higher PC with Windows 95, 3.1, 3.1 / 4MEG RAM / 7MEG HD Space. FirstAID 95 Ver. 2.0 ..... \$14.95 Ea.

## NEW TEAC 1.44 MEG 3.5" FLOPPY DISK DRIVE

New Standard 1.44 Meg 3.5" floppy disk drive. Manufactured by Teac. Model #FD-235HG. Face plate color: Beige. 34 pin interface connector with 4 pin power.

FD-235HG Teac 1.44M ..... \$32.95 Ea.

## 3D HOME ARCHITECT

New retail boxed CD-ROM version for Windows 95 & 3.1. The complete software solution for easy home design. Easily create detailed floorplans, customize from over 400 furniture and fixture library items. View finished product in 2D and 3D. Over 150 sample plans included. System Req: 486 or higher Windows 95 or 3.1, 4MEG RAM / 8MEG HD SPACE / 2X CD-ROM / VGA or better. 3D Home Architect ..... \$19.95 Ea.

## NEW PCMCIA 10 MEG FLASH MEMORY CARD

Made by Sundisk. (Read/Write 5VDC.) Works with any laptop or PDA with PCMCIA ATA Spec. interface & software drivers. (\*Software drives not included\*)

(Note: 10 meg is uncompressed capacity) Platform compatibility: HP 100LX/200LX IBM TP 350, 365, 500, 750, 755, and others, contact Sundisk for your specific model. Cards are Plug-Play Windows 95 compatible. Sundisk 408-562-0595 or [www.sandisk.com](http://www.sandisk.com)

SDP5-10 SUNDISK ..... \$124.95 Ea.

## NEW INTEL PENTIUM 60/66 CPU HEATSINK 12VDC FAN COMBO

New Pentium 60/66 heatsink 12VDC fan combo for cooling the older, hotter, CPUs. Low profile type with seven inch wires. Can be used on other CPUs if you have the physical space.

Pentium 60/66 CPU Cooler ..... \$4.95 Ea.

## NEW TEAC COMBO 700 TAPE BACKUP AND FLOPPY DRIVE 1.44 3.5"

The Teac combo is a 3.5" floppy drive and QIC tape backup unit built into 5.25" half height frame. Great for systems with limited drive bays. Tape backup unit utilizes the PC's existing floppy controller. Capacity: 680MB compressed/340MB uncompressed. Tape Format: QIC-3010-MC. Data Trans. Rate: 0.5 & 1Mbps. Tape Media: 3M MC300XL (400 ft.). Software Incl: Arcada Backup for Windows 95, Windows 3.1 & DOS (1.44 Meg floppy). (Note: Back-up tape or cables not included with drive.)

FF-3101/700 Combo ..... \$69.99 Ea.

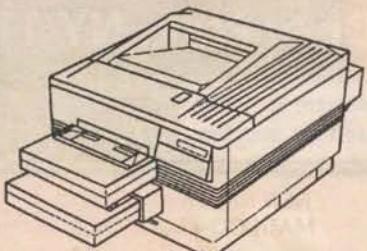
Write in 51 on Reader Service Card.

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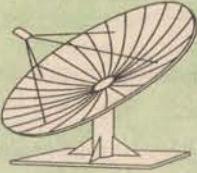
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11729C, Carrier Noise Test Set	\$18,000	\$650
16510B, 80 Channel, 25MHz State & Timing Module	\$1000	\$900
1652B, Logic Analyzer w/Oscilloscope	\$4000	\$16,000
214A, Pulse Generator, 0.08V to 100V	\$200	\$400
3311A, Function Generator, .01Hz-1MHz	\$225	\$1850
3312A, Function Generator, .1Hz-13MHz	\$700	\$1700
3314A, Function Generator, .001Hz-19.99MHz	\$2800	\$650
3325A, Synthesizer/Function Generator	\$1800	\$400
334A, Distortion Analyzer	\$250	\$1400
339A, Distortion Analyzer	\$1800	\$1500
3455A, Digital Voltmeter	\$400	\$2650
3456A, Digital Multimeter, 6.5 Digits	\$800	\$7.18
3478A, Digital Multimeter	\$700	Capable of 60GHz with Mixers
3488A, Switch Control	\$1000	\$2500
3551A, Transmission Test Set	\$950	\$450
35677A, S-Parameter Test Set	\$2700	\$1700
3575A, Phase Gain Meter 1Hz-13MHz	\$1000	\$400
3581C, Selective Voltmeter	\$800	\$4000
3582A, Spectrum Analyzer, .02Hz-25.5KHz	\$2500	\$975
3585A, Spectrum Analyzer, 20Hz-40MHz	\$7500	\$1650
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4191A, RF Impedance Analyzer	\$12,500	\$1450
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5316B, Universal Counter	\$1000	\$TR503, Tracking Generator for 492/4/5/6
5328B, Universal Counter	\$1000	\$850
5334A, 100MHz Universal Frequency Counter	\$1400	MISCELLANEOUS
5334B, Universal Counter	\$1200	Acme Elect. PS2L1000, Electronic Load
5335A, Frequency Counter, opt. 10/20	\$1200	Boonton 102F, AM/FM Signal Generator, DC-1040MHz
5340A, Frequency Counter, 10Hz-18GHz	\$800	Eaton 2052B, Amplifier, 100-512MHz
5354A, Frequency Converter	\$800	Fluke 5100B/03/05, Multifunction Calibrator
5355A, Frequency Converter	\$1000	Fluke 5100B/05, Multifunction Calibrator
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54201A, Digitizing Oscilloscope, 300MHz	\$2500	Fluke 5440B, Precision DC Voltage Calibrator
54201D, Digitizing Oscilloscope	\$2650	Fluke 6060B, Synthesized Signal Generator, .01-1050MHz
6002A, Opt. 1, Power Supply, HP-IB, 0-5V/0-10A	\$700	Fluke 6160B, Synthesizer, Opt. 09
6024A, DC Power Supply, 0-60V/0-10A	\$1000	Fluke 845AB, Null Detector
6034A, DC Power Supply, 0-60V, 0-10A	\$1650	Fluke 845AR, Voltmeter/Null Detector
6038A, DC Power Supply, 0-60V, 0-10A	\$1800	Fluke 8520A, Digital Multimeter
6186C, DC Power Source, 0-300V, 0.100 MA	\$850	Fluke R8840, Rackmount Digital Multimeter w/059 Option
6227B, Dual Power Supply, 0-25V/0-2A	\$600	Gen-Rad 1482B, Standard Inductor, 100UH
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6469C, DC Power Supply, 0-36V, 0-300A	\$3000	Gen-Rad 1482L, Standard Inductor, 100mH
6622A, Dual DC Power Supply	\$2350	Gen-Rad 1482P, Standard Inductor, 1 Henry
6623A, Triple Output Power Supply	\$2800	Gen-Rad 1633A, Incremental Inductance Bridge
7090A, Measuring Plotter	\$2000	Hughes, Amplifier 18-26.5GHz, 1 Watt
8012B, Pulse Generator	\$750	IFR NAV750B
8013B, Pulse Generator	\$750	Keithley 195A, System DMM w/Temp
8165A/002, Programmable Signal Source w/AM	\$2200	Kikusui PAD16-10L, Power Supply, 16V, 10A
8182A, Data Analyzer	\$1500	Kikusui PLZ700W, Electronic Load
8350A, Sweep Oscillator Mainframe	\$3000	Krohn-Hite 3202/R3202, Tunable Filter
8350B, Sweep Oscillator Mainframe	\$4000	Rack Version
83522A, Oscillator Plug-In, .01-2.4 GHz	\$5500	Krohn-Hite 3342, Tunable Filter
83540A/002, RF Plug-In, 2.8-4GHz	\$5000	Phillips 5191, Prog. Synthesizer/Function Gen.
83545A, Oscillator Plug-In, 5.9-12.4GHz	\$2500	0.1MHz-2.147MHz
8411A/018, Frequency Converter, 1.1 to 18GHz	\$500	Phillips PM5715/11, 50MHz Pulse Generator (New)
8444A, Tracking Generator w/Opt. 059	\$1200	8 Digit, 120MHz
853A/8558B, Spectrum Analyzer, 100KHz-1500MHz	\$3850	Solairon 1250, Frequency Response Analyzer
853A/8559A, Spectrum Analyzer, 10MHz-21GHz	\$4750	Trans Devices DLR400 15 3500A, Dynamic Load
8563A, Spectrum Analyzer, 9KHz-50GHz (Mixers Included)	\$26,500	Wavetek 166, Pulse Function Generator
8566A/B, Spectrum Analyzer, 100Hz-22GHz	\$35,500	Wavetek 178, Automatic Synthesizer
8569A, Spectrum Analyzer, .01-22GHz	\$6500	Wavetek 2002, Signal Generator, 1-2500MHz
8569B, Spectrum Analyzer, .01-22GHz	\$7500	Wavetek 3000, Signal Generator, 1-520MHz
8620C/86222B, Sweep Oscillator, .01-2.4GHz	\$1800	Wavetek 3000-200, Signal Generator
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8640B, Signal Generator, Opt. 1, 2	\$2200	Wavetek 801, Pulse Generator, 5Hz-50MHz
8654A, Signal Generator, 10-520MHz	\$600	Wavetek 802, Pulse Generator, 5Hz-50MHz w/Delay
8656A, Signal Generator, 10-520MHz	\$800	Wavetek 803, Precision Scalar Analyzer
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8662A, Synth. Signal Gen., 10KHz-1200MHz	\$30,000	Wavetek 859, 50MHz Programmable Pulse Generator
8673B, Synth. Signal Gen., 2.0-26.5GHz	\$18,000	Wavetek 907A, Signal Generator, 7-12.4GHz
8672S, Synth. Signal Gen., .01-18GHz	\$13,000	OUR NEW INTERNET ADDRESS IS: <a href="http://www.rssurplus.com">http://www.rssurplus.com</a>
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8746B, S-Parameter Test Set, 5-12.4GHz	\$700	
8748A, S-Parameter Test Set w/Opt. 026	\$2500	
8754A/H26, Network Analyzer, w/8748A Opt. 026	\$6000	
8770A, Arbitrary Waveform Synthesizer	\$3000	
8901B, Modulation Analyzer	\$5000	
8903B/001, Audio Analyzer	\$3000	
8904A/001/003, Multifunction Synthesizer	\$2800	

### TEKTRONIX

1750, NTSC Monitor	\$1800
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NUTS & VOLTS MAGAZINE  
NEW PRODUCT EDITOR,  
430 PRINCETON CT., CORONA, CA 91719

## EX JUMBO HOPPER

Chenesko Products, Inc. announces the addition to their product line of a new EX Jumbo Hopper, which fits all standard HP OEM EX toner cartridges increasing capacity up to 600 grams of toner.

The new EX Jumbo Hopper is designed to fit and expand the toner capacity of the three standard HP EX toner cartridges — Models C-3973A; 92298A; and the new 92298X. The resulting Jumbo EX Cartridge will fit into both the HP LaserJet 4 & 5 series of printers.

For more information, contact:

CHENESKO PRODUCTS, INC.  
2221 FIFTH AVE., STE. 4  
DEPARTMENT NV  
RONKONKOMA, NY 11779  
516-467-3205 1-800-221-3516

## R11 TEST RECEIVER



Optoelectronics, Inc. announces the new R11 nearfield FM test receiver. The R11 sweeps from 30MHz-2GHz in less than one second locking onto the strongest signal in the nearfield, up to 600 feet away with a 5-watt UHF transmitter. Once the R11 locks onto a signal, the FM audio is demodulated through its built-in speaker allowing the user to monitor that transmission.

The R11 incorporates 10 LEDs on the front panel as a way of indicating

the general frequency range of the captured signal. Each LED has a specific numerical value with each representing a particular frequency. Another new feature to the R11 is its ability to lock out up to 1,000 unwanted frequencies like, FM stations, TV stations, paging towers, etc. Using a specific power-up sequence, an approximate number of lockouts in memory will be indicated by the illumination of one of the LEDs with numerical values. The R11 also incorporates a hold feature so that a frequency can be monitored until the sweep function is enabled.

Another unique feature of the R11 is its ability to interface with the Optoelectronics Scout Frequency Recorder for Reaction Tuning. Both the R11 and Scout have CI-5 interface jacks which allow a 2.5 mm mono cable to connect the two so the Scout may Reaction Tune the R11 to the frequency it captures. All versions of the Scout can Reaction Tune the R11. In addition to Reaction Tuning, the Scout may also Memory Tune the R11 by recalling any one of its possible 400 frequencies in memory.

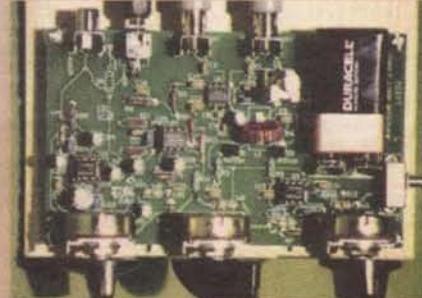
The retail price of the R11 test receiver is \$399.00.

At the time of this release the R11 Test Receiver had not been approved for sale by the FCC.

For more information, contact:

OPTOELECTRONICS, INC.  
5821 N.E. 14TH AVE., DEPT. NV  
FT. LAUDERDALE, FL 33334  
954-771-2050 FAX: 954-771-2052  
1-800-327-5912  
E-MAIL:  
[sales@optoelectronics.com](mailto:sales@optoelectronics.com)  
WEB: [www.optoelectronics.com](http://www.optoelectronics.com)

## THE SLR RECEIVER



Jade products, Inc. announces its first receiver kit, The SLR Receiver. Designed by N1BYT, this Shielded Loop Receiver is a revolutionary approach to small receiver design.

The receiver is small; all of the circuitry is contained on a single 3" x

# News

5" PC board. The accompanying indoor antenna stands about one-foot tall.

The kit comes in two flavors. The SLR-40 can be configured for either the 30M or 40M bands. The SLR-80 is for the 80M band. The kit comes complete and the detailed manual simplifies assembly. All you need is a nine-volt battery and headphones, or a small speaker. The receiver can be mounted in an enclosure or on a small piece of wood. It does not have to be shielded.

The receiver tunes the entire 30M band, about 250 KHz of the 40M band and about 140 KHz of the 80M band. It can detect a 0.1  $\mu$ V signal. Current drain is less than 10 mA with moderate headphone volume, using a nine-volt battery.

To order the kit from Jade Products, Inc. please specify which model, SLR-40 or SLR-80. The kit cost \$95.00 plus \$6.50 S & H.

For more information, contact:

JADE PRODUCTS, INC.  
P.O. BOX 368, DEPT. NV  
EAST HAMPSTEAD, NH 03826  
1-800-JADEPRO  
FAX: 603-329-4499  
E-MAIL: [jadepro@jadeprod.com](mailto:jadepro@jadeprod.com)  
WEB: [www.jadeprod.com](http://www.jadeprod.com)

## TECHTOYZ MICRO COUNTER



Optoelectronics, Inc. announces the second product to be released under the new Techtoyz name, the Micro Counter.

The Micro Counter is housed in a pager-style case making portable

operation easy and convenient. Just clip the counter on your belt or put in your pants pocket or jacket pocket.

With a frequency range of 10 MHz to 1.2 GHz, the Micro Counter can lock onto a 5 watt UHF radio from as far away as 125 feet using the optional TMC100 rubber duck antenna. With an initial accuracy of 1 ppm and a sensitivity level of <5 mV, the Micro Counter is ideal for testing radios in the shop or in the field. In addition, there are three selectable gate times for increased resolution of the frequencies captured.

The Micro Counter has four modes of operation: normal, filter, recall, and our patented digital auto capture. Once a frequency has been captured, it will be logged into one of three memories for later recall.

The new Techtoyz Micro Counter retails for \$99.00. The optional TMC100 antenna retails for \$9.00.

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954-771-2050 FAX: 954-771-2052  
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WEB: [www.optoelectronics.com](http://www.optoelectronics.com)

## PC HF FACSIMILE 8.0 FOR WINDOWS



SSC announces the release of PC HF Facsimile 8.0 for Windows. PC HF Facsimile 8.0 allows users of Windows PCs to receive wfax charts, weather satellite photographs, radio teletype, NAVTEX, FEC, SITOR, ASCII, and Morse code digital news, and weather broadcasts.

By connecting the package's demodulator between the computer's serial port and a single side band shortwave communications receiver, digital radio transmissions can be received, displayed, printed, or recorded on disk.

SSCs new Windows FSK demodulator allows the program to operate in the background while the operator is performing other tasks under Windows.

The package is ideal for

## New Product News

mariners, aviators, agriculture, and weather enthusiasts.

The package includes image and text decoding software, a miniature demodulator, tutorial audio cassette, comprehensive manual, world wide frequency list, and broadcast schedules. System requirements are: Window 3.1x, Windows 95, or Windows NT, 8 MB RAM memory (4 MB under Windows 3.1x), 6 MB hard disk space.

Suggested retail price is \$179.95.

For more information, contact:

**SSC**  
615 S. EL CAMINO REAL  
DEPARTMENT NV  
SAN CLEMENTE, CA 92672  
714-498-5784

### IC-T7AHP TRANSCEIVER



Available immediately, ICOM's IC-T7AHP dual-band (two meter/440 MHz) handheld transceiver now comes standard with a BP-173 battery pack enabling it to have four watts of output power. Coupled with its other features, the IC-T7AHP offers hams a "high powered" compact handheld with VHF and UHF capability.

With a height of about four inches, the palm size IC-T7AHP is designed for both convenience and easy operation. The keypad is well spaced and comes with a "thumb

touch" lock-switch and "single push action" feature selection (no function key). Changing bands may be achieved by simply depressing the band key to toggle between two meters and 440MHz.

Storing up to 70 channels in any combination of VHF or UHF frequencies, this handheld has nine DTMF (dual-tone multifrequency) memories for auto dialing. The IC-T7AHP also provides 50 separate encode and decode frequencies, as well as a tone scan function for easy subaudible tone selection.

For more information, contact:

**ICOM AMERICA, INC.**  
2380 116TH AVE., N.E. DEPT. NV  
BELLEVUE, WA 98004  
425-454-8155 FAX: 425-454-1509  
<http://www.icomamerica.com>

### HIGH-PERFORMANCE RECEIVER



Neulink introduces the DCL-VHF-NRX high-performance, synthesized, digital receivers operating in the 153 MHz to 173 MHz and 450-470 MHz bands, respectively.

They are currently being used in the National Emergency Alert Systems and Law Enforcement applications.

The receivers support digital data, and have excellent audio output that outperforms many high-end commercial radios.

The band spread is 10 MHz in the 153/174 MHz, and the receivers can be tuned to any frequency in the selected band.

For more information, contact:

**RF NEULINK**  
7610 MIRAMAR RD., DEPT. NV  
SAN DIEGO, CA 92126  
619-549-6340 FAX: 619-549-6345  
1-800-233-1728  
E-MAIL: [rfneulink@aol.com](mailto:rfneulink@aol.com)

### DIGITAL SATELLITE UPCONVERTER



The RFPS Digital Satellite Upconverter is ideal for testing multirate DVB/MPEG-2 compatible QPSK set-top receivers and

modems, in both the R & D and production test environments.

It is also well suited to other applications, notably analog DBS receivers and PCS systems.

It provides a low-cost alternative to achieving a high-performance frequency translator assembled from off-the-shelf commercial signal generators, mixers, amplifiers, and filters.

The Upconverter accepts digital or analog modulator outputs at 70 MHz, and translates them directly to the 1940-2800MHz input band of DBS/DSS/PCS/PHS/WLAN receivers, effectively eliminating the need to set up a complete C or Ku band upconverter to LNB conversion chain.

The Upconverter provides amplitude, group delay, phase noise, and spurious output performance needed to support QPSK receiver testing at symbol rates between 1 and 45 MSPS.

It offers several convenience features, including switchable IF inputs and an input for noise injection at the IF. Ultra-low phase noise options are available for low data rates.

For more information, contact:

**RF PROTOTYPE SYSTEMS**  
9400 ACTIVITY RD., STE. J  
DEPARTMENT NV  
SAN DIEGO, CA 92126  
619-689-9715 FAX: 619-689-9733

### PHD TELECOMMUNICATOR



The PHD Telecommunicator combines four tools in one.

This enhanced set integrates all the features of a butt set, hands-free monitor, signal level meter, and digital multimeter.

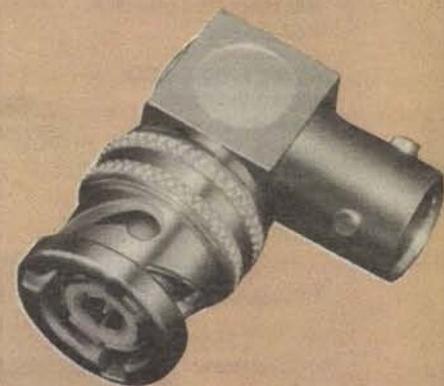
The LCD shows tone and pulse digits, including on/off time and dB level for tones, or percentage of break, pulses-per-second, and inter-digit time. The set also monitors the line status (on or off hook), zero-volt intervals, and non-DTMF voice band tones. DMM measures AC and DC voltage to 199.9V and DC current to 199.9 mA.

For more information, contact:

**JENSEN TOOLS, INC.**  
7815 S. 46TH ST., DEPT. NV

**PHOENIX, AZ 85044**  
602-968-6231 FAX: 602-438-1690  
1-800-426-1194  
<http://www.jensentools.com>

### RIGHT ANGLE TRB ADAPTER



Trompeter Electronics introduces the ADRMF70, a right-angle TRB male-to-female adapter.

The unique adapter has a concentric design throughout.

The ADRMF70 is ideally suited for telemetry and ground support 1553 data bus applications where cable management strength, and security are priorities.

The ADRMF70 is available at \$35.70 per 1,000 pieces.

For more information, contact:

**TROMPETER ELECTRONICS**  
31186 LABAYA DR., DEPT. NV  
WESTLAKE VILLAGE, CA 91362  
818-707-2020 FAX: 818-706-1040  
1-800-982-2629  
[www.trompeter.com](http://www.trompeter.com)

### PORTABLE 13-CHANNEL LOGIC ANALYZER



The 13-channel Logic Analyzer (LA) is an essential tool for anyone testing or troubleshooting digital circuits. The LA converts an IBM compatible computer or laptop into a fully functional logic analyzer. It is similar to an oscilloscope used in analog circuits except the LA has extensive triggering and can store waveforms for detailed analysis. Price is \$250.00 US.

For more information, contact:

**GAMBIT TECHNOLOGIES, INC.**  
5115 TRANS ISLAND, STE. 240  
DEPARTMENT NV  
MONTREAL, QUEBEC, H3W 2Z9  
CANADA  
514-489-7055 FAX: 514-484-8021

## Serial Display Modules

We offer top-quality LCDs that accept data through a serial interface at up to 9600 baud. Easy to use with computers and controllers (e.g., BASIC Stamps, PCs)—if you can send serial (RS-232), you can have a display working in minutes!

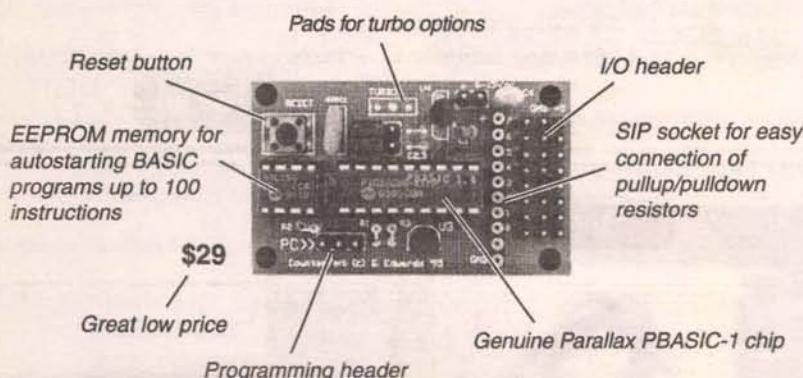
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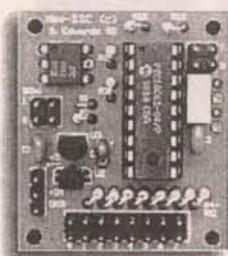


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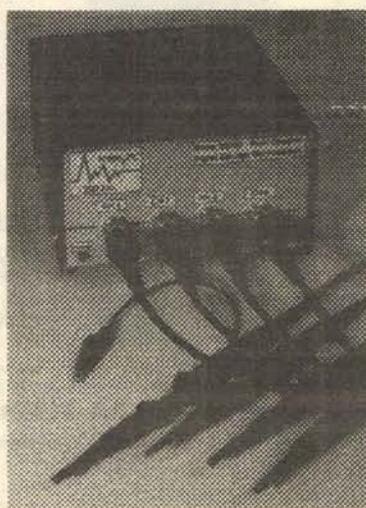
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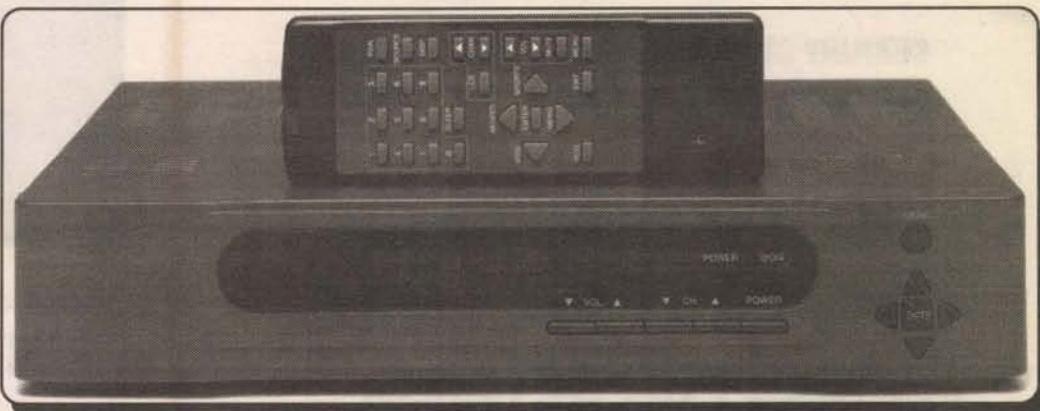
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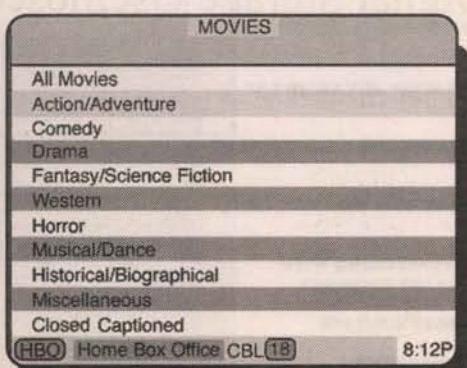
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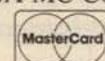
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by Karl Lunt

## Fire in the Home!

**T**he 1998 Trinity College Fire-Fighting Home Robot Contest takes place April 18 and 19, on the Trinity College campus in Hartford, CT. The contest's home page at [www.trincoll.edu/~robot](http://www.trincoll.edu/~robot) claims "this is the largest, public, true Robotics competition held in the US that is open to entrants of any age, ability, or experience from anywhere in the world." Be that as it may, the contest offers a serious robotics challenge, so I figured I'd give it a shot.

Briefly stated, your robot must move through a mock floor-plan of a house, locate a fire (actually, a lit candle), and extinguish the flame. Bonuses and penalties are applied, as necessary, to arrive at an operating score for each of three runs. The lowest operating score on the two best runs serves as the robot's overall score, and the lowest overall score wins the contest.

Note, however, that it is not enough just to put the robot on the floor and hope for the best. Your robot must find the candle and put out the flame in at least two runs just to qualify for a prize; any run in which your robot fails to put out the flame isn't counted for scoring.

The contest rules include several penalties that will further separate the very best machines from the rest of the herd. Touching a wall, with either the robot body or a feeler, gets your machine an immediate five-point penalty for each occurrence. Run a feeler along the wall ... that'll cost your machine one point per inch traveled, plus the contact penalty. And touching the candle means a fast 50 extra points slapped on your robot's time score.

As for positive reinforcement, the contest format rewards those robot designers who put in the extra effort. If your robot starts its run based on a sound signal supplied by the referee, it gets 5% off of its time score. Putting out the flame, then returning to the starting point nets a 10% reduction. If your robot does its thing with furniture (actually, yellow steel cylinders) in each room, it nets a 30% bonus. And any robot that puts out the candle on all three runs gets an additional 10% off of its best score.

This is not an exhaustive list of the penalties and bonuses; get a copy of the rules or check the web site for the official information. But these details show the care the organizers have put into designing the event. The format gives you a wide range of options in your strategy. For example, you might emphasize speed and the ability to return to the starting point, hoping to make a fast enough run to out-class another builder whose robot runs more slowly, but in "furniture-mode."

One interesting aspect of this event concerns the floor plan. It is known, within limits, well before the event starts. In fact, I've included a copy of the approximate floor plan for you to review. Note, however, that this is only an approximation. The actual contest floor plan may vary by as much as one inch in any dimension from those shown.

The designers have made a few aspects of the contest robot-friendly. The walls are all painted flat latex white, the floor is flat black, and the starting point is a 12" white circle painted on the floor. Even the candle is easier to find than it might be; the designers have mounted it on a 3" by 3" yellow wooden base. Other navigational aids, such as 1" wide white lines to mark the doorways, will make your job as robot designer somewhat easier, but only somewhat. This is still a challenging contest.

Jake Mendelsohn has been involved with this contest for years, and serves as a contact point. You can order a copy of the updated rules to the

# AMATEUR ROBOTICS

1998 event by sending a \$3.00 check or money order, payable to Trinity College, to Jake at the address listed elsewhere in this article. For \$25.00, you can order a 57-minute VHS video tape of highlights from the 1997 event.

The fire-fighting contest runs in two divisions. The Junior section is limited to those in high school, while the Senior section covers everyone else. Talk about a perfect contest for that Science Fair project! What's more, first place in each division garners a cool \$1,000.00 cash first prize, with additional awards for other top finishers. Again, check the official rules and web site for details.

Okay, so this is a way cool robot event. But I'm stuck in the rain and drizzle of the Puget Sound, so why am I pumped about a contest being run clear across the country? Because the Seattle Robotics Society is hosting the Northwest Regional for the Fire-Fighting Home Robot Contest, on March 21, 1998.

Last year's event in Hartford drew over 80 robots, and the running time became so long that it basically filled an entire weekend. To try and contain the chaos, Trinity College decided to hold several regional events, with winners moving on to the finals in Hartford, and the SRS is happy to be involved. Current plans call for first prize in both divisions to include some subsidy from Trinity College on air-fare to Hartford, so the winners can participate in April. Those of you who live elsewhere in the robotic hinterlands should check the contest's web page for details on the other regional events.

Several SRS members have already swung into action, committing to build the necessary frames and venues needed to host the event, and to build robots that can compete. You can find out more information on the SRS' involvement by hitting our web page at: [www.seattlerobotics.org](http://www.seattlerobotics.org) — Also watch this column for more details as they become available.

## Getting started

I began my first-order solution to the robot design by stretching out on the couch with a beer nearby. After much mulling, I decided to begin with a round base and a direct-drive stepper motor drive system. The contest rules limit the robot to a 12" cube and the running time shouldn't be too great, so I should be able to keep the weight low enough so the steppers will work. I'm expecting the stepper motors to help with another problem — that of navigation.

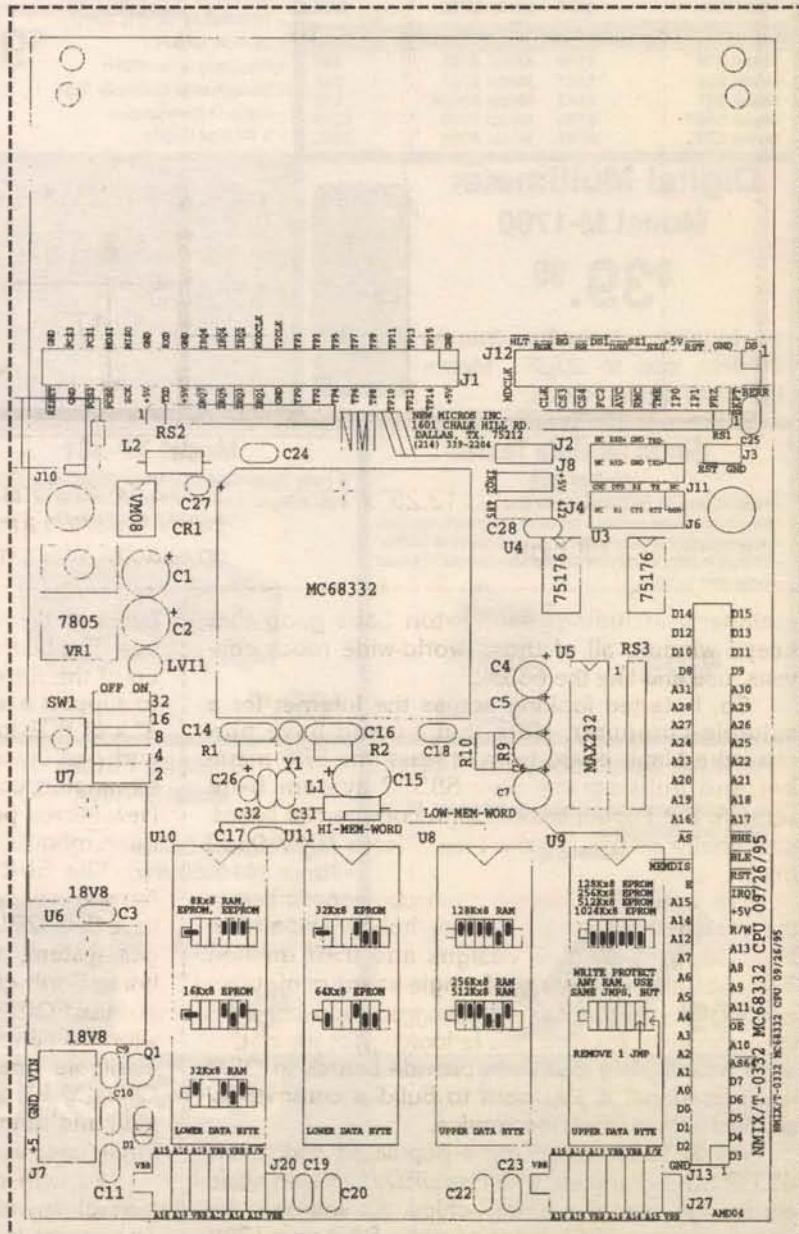
The robot's computer will already have a workable map of the house, but knowing how to get from point A to point B means you have to move reliably. One method of moving precisely involves encoders attached to wheel shafts or to a

rolling floor contact. Another technique uses very precise motion increments, such as those supplied by steppers.

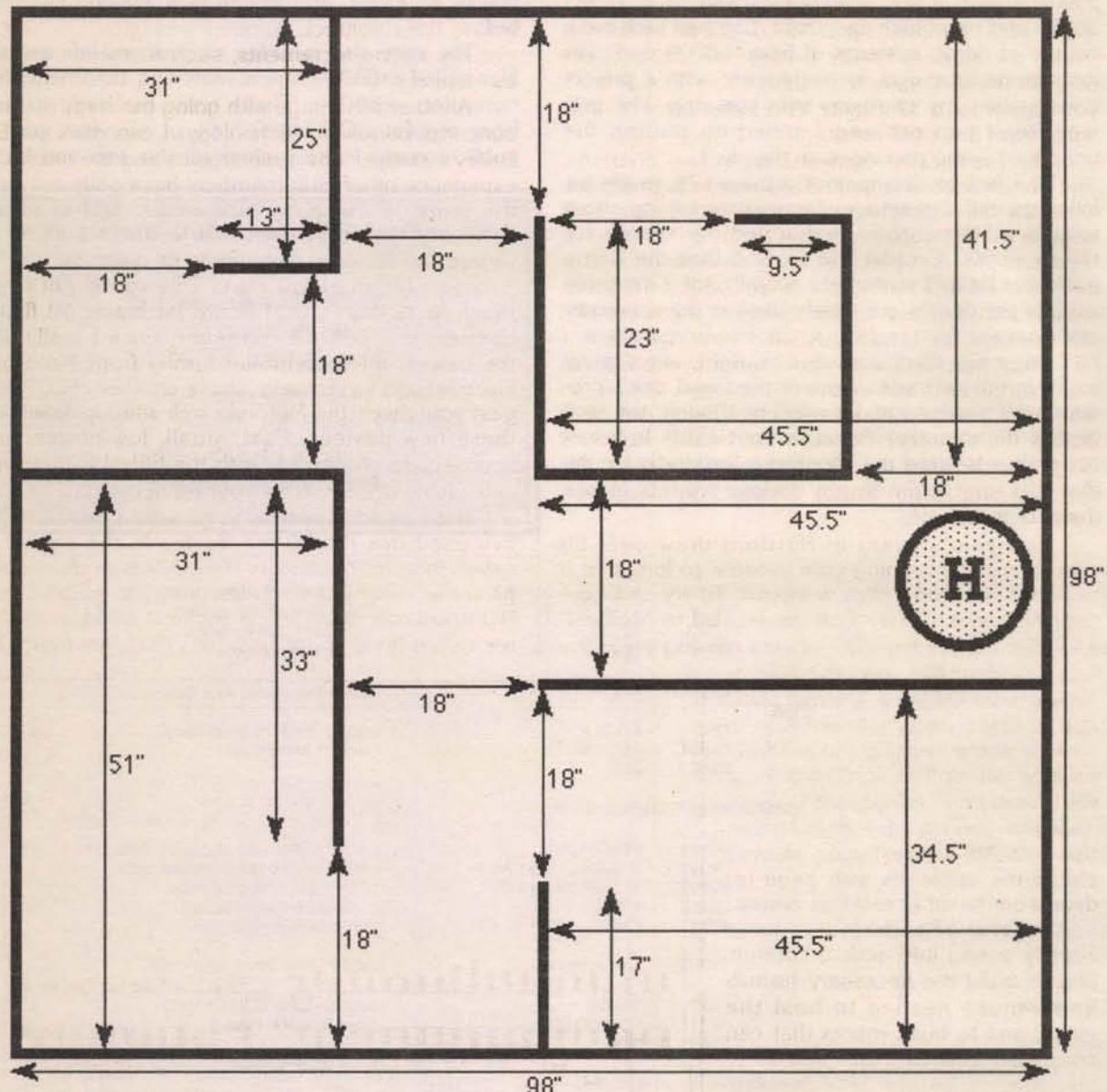
Another advantage with going the stepper route concerns borrowing technology. I can draw on Bill Bailey's stepper driver electronics and the wealth of experience other club members have gathered over the years, to make my task easier. Add a gel-cell battery of the proper size and weight, a little bit of wiring, and the easy part should be done.

Now for the hard part. This robot will need much more than a BOT-Board for brains. At first, I considered a 68hc12 computer, since I really like the newest microcontroller family from Motorola. Even though I eventually chose another chip, I suggest you check the Motorola web site for details on these new devices. Fast, small, low-power, and source-code compatible with the 68hc11, they provide plenty of oomph for your robot designs.

But I decided instead to go with a 68332 MCU. I've used this 68000-like device in the past, but never in a robot design. The 32-bit architecture, powerful addressing modes, and lots of on-board I/O and timer subsystems make it an ideal choice for upper-level robot designs. Plus, several SRS



**Trinity College FIRE FIGHTING**  
**Home Robot Contest**  
**1998 Arena Floor Plan**  
**Contest Rules, Attachment A**  
© Copyright 1997 Trinity College



Maximum size of Robot is 12.25" x 12.25"

All walls are 13" high

These dimensions are approximations and are NOT 100% accurate and that's why the numbers don't add up exactly. Welcome to the real world!

members, including the Newton Labs gang that keeps winning all of those world-wide robot contests, use and like the 68332.

So, I started looking across the Internet for a suitable computer. Note that I could have purchased a blank board from at least one SRS member and built up my own 68332 system from scratch. But I opted instead for a commercial board, and finally settled on the New Micros NMIX-0332 unit.

I've used New Micros' products many times in the past, both for my job and my hobby, and always been happy with their designs and their quality. They sell a large variety of single-board computers and peripheral boards, and I suggest you consider their products anytime you're looking for an off-the-shelf board. They can even provide boards in OEM configurations, if you want to build a commercial product around their electronics.

My \$239.00 netted me a populated and tested 68332 SBC, complete with four JEDEC 32-pin sockets for my mix of memory chips. As shipped, the board contains 256K bytes of static RAM and 128K

bytes of EPROM, both arranged on a 16-bit data bus. The board contains provisions for battery backup of the RAM, and you can restrap the electronics to support a wide variety of different chip sizes. The 4" x 6" PCB includes a useful-sized prototyping area and pad layouts for I/O signals. It also sports an expansion connector that mates with any of the New Micros peripheral boards, should I need to add more robot horsepower quickly.

The SBC arrived with two strong pieces of firmware already installed. The pair of EPROMs contain CPU32BUG, Motorola's 32-bit monitor/debugger system, and Max-FORTH, New Micros' workhorse Forth compiler. I've used the eight-bit version of Max-FORTH on several projects before, mostly with the 68hc11 SBCs, so I like having that option available when it comes time to write code. And CPU32BUG provides some real power for debugging and running any assembly language programs I may need to try out.

As with other New Micros' products, I went through my usual likes and dislikes with this board. The design is clean and well-done, and the board is

well-made and has lots of features on it that I like. But the documentation is very haphazard, and could serve as a barrier to those not well versed in details of microcontroller design.

For example, the docs include two pages of schematics, both D-size and reduced to single 8-1/2" by 11" sheets, then photocopied, so you can imagine how difficult they are to read. The page labeled "Memory Map" contains a single paragraph of vaguely relevant information, but no memory map. There is no well-designed manual that takes you step-by-step through the board and its capabilities, just 31 pages of printed material on assorted topics. I also got a floppy disk containing additional software, such as a public-domain assembler and a public-domain C compiler, and text files related to Max-FORTH and the NMIX-0332.

To their credit, New Micros does include a spiral-bound manual on CPU32BUG and a copy of the MC68332 *User's Manual* — both vital tools — but they are actually printed and distributed by Motorola. The bottom line: I love New Micros' hardware and firmware, but if this is your first microcontroller, you might have more success going with another vendor.

#### The software

Next up, I needed some form of compiler and assembler for developing my robot code. I briefly considered modifying SBasic so it could support the 68332, but discarded the idea for this project. That doesn't mean I've given up on the notion entirely; you may yet see a 68000 SBasic. But it won't likely be done for the Fire-Fighting contest.

No, this kind of project needs a higher-horsepower solution than SBasic. Assembly language for the whole project is right out; I'm not that big of a masochist. But elements of the project will require some low-level work, so an assembler is necessary. This still leaves me with a decision on the high-level tool.

After much thought, I ended up opting for C. I actually prefer doing robotics in Forth, but face it, C is more widely known, and explaining C functions to someone without a lot of programming experience is going to be easier than explaining those same functions written in Forth. (Been there, done that.)

So having chosen a language, I now needed to find the toolset. My requirements list for this assembler/compiler package was short but firm. One, it had to be free. Not cheap, free. I figure several of you will try to duplicate or improve on my efforts as these columns go by, and I'm not going to start off with a \$2,000.00 compiler suite and expect you to follow suit. What's more, I'm just as cheap as the next cash-strapped hobbyist.

Second, I wanted an assembler/compiler system that was well-regarded by other users, sported a good set of features, and didn't take a Master's in CS to use or maintain. Note that wanting a commercial-grade package doesn't necessarily conflict with item one above; it just means I have to look a little harder and be a little more discriminating.

Finally, the compiler had to generate good, compact code. I realize that after working on a 2K platform for several projects, 128K of code space seems like oceans of room. But bloated code builds up fast (can you say "Windows?") and, at this point, I can't see the end of the project, so I'll err on the side of caution.

With this list in mind, I headed for my favorite freeware shopping mall, the Internet. After a few hours with AltaVista, I uncovered some candidates. The Free Software Foundation maintains a suite of tools based around the Gnu C compiler. Doing a web-search for gcc turned up a raft of various Gnu spinoffs. Many of these sites contain the full source code and build files for making gcc compilers for nearly any chip, including the 68000.

As an aside, you can even find a gcc for the 68hc11, should you want to try this compiler on the

# ROBOTICS . . . ROBOTICS . . . ROBOTICS . . . ROBOTICS . . . ROBOTICS

eight-bit Oli Kraus' web site at [www.e-technik.uni-erlangen.de/~kraus/olihc11.html](http://www.e-technik.uni-erlangen.de/~kraus/olihc11.html) contains a full 68hc11 implementation of the gcc cross-compiler.

Those hardcore software hackers out there should note, however, that this is an executable only, no source. Also note that despite repeated efforts, I was unable to get a working set of va\_arg macros running, so I could not create functions with variable-length argument lists, such as printf(). But I really like this compiler, even with these problems, and you may yet see a 68hc11 or 68hc12 design based on this tool.

But the Gnu tools really require more software expertise to use and maintain than I was willing to accept for my project and my readers, so I continued looking. Another possibility lies in the public-domain C compiler provided by Motorola and shipped on the New Micros floppy disk. The disk contains the executable for both the C compiler and the matching assembler. It also contains what looks like the full source code for the C compiler, though I haven't tried rebuilding the compiler yet.

But the .doc file on the compiler indicated a few problems that left it short of my requirements list. Again, however, those software hackers out there could have a lot of fun with this compiler. Wally Brandt, the original developer of this compiler, did a terrific service to the 68000 community when he released his work, and I'd like to see others carry onward from there. Given the long expected life of the 68000 family and the ever-growing number of hobbyists on the prowl for cheap tools, an upgrade

to this compiler would find a lot of grateful users. Think about it.

Meanwhile, back at the ranch, I was running out of options. I had found two good compilers that were more of a software project than I was willing to tackle just to get a robo-tool running, and I still needed a compiler and assembler. Then, in a fairly typical Zen thunderbolt, the answer called me up one morning at work.

Louis Meadows is a sales rep for a company called Software Development Systems, which makes a suite of very powerful software tools for the 68000 and other high-end chips. Lou had sent me a couple of demo systems of SDS' 68000 compiler tools some time ago, in conjunction with a project investigation my company was pursuing. The project didn't pan out and I ended up putting the unopened demo packages on the shelf.

So I had to disappoint Lou when he made his follow-up call. But we spent some time talking about related matters, and I mentioned my search for cheap 68000 C tools. He replied that the demo packages he had sent might actually solve my problem, as the demos are widely used in the university environment for teaching C on microcontrollers. I had originally dismissed this outright, since most such demo packages are crippled and can't produce very much code. Lou said he thought the limit on the demo compiler was about 100K bytes of code. He answered my shocked question by saying that you can't really do any serious projects in less than 100K of code.

As soon as we hung up, I ripped open one of the demo packages and installed it. The more I read and tested, the more convinced I became that this was the end of my software search. The seven-floppy package contains SDS' C/C++ Starter Kit for the 68K, version 7.03, which runs under Windows 3.1, Win95, and WinNT. The main product is the SingleStep 68000 debugger and simulator, a powerful Windows-based program for testing your final object files. SingleStep is crammed with powerful features such as source-level debugging and breakpoints, an editor, and built-in downloading capabilities.

The suite also includes a command-line assembler called as68000 and a matching command-line compiler, cc68000. These tools are easy to use from regular DOS batch files, or you can grab a public-domain Make system off the web and build

For Fire-Fighting Contest videos or information, see the Trinity College web site or contact:

### Jake Mendelsohn

190 Mohegan Drive  
West Hartford, CT 06117

### New Micros, Inc.

1601 Chalk Hill Rd., Dallas, TX 75212  
Voice: 214-339-2204  
[www.newmicros.com](http://www.newmicros.com)

Typical 68332 startup file, based on original provided by Software Development Systems in their SDS Startup Kit.

Use the Motorola equate file to declare the 68332 I/O registers.

```
#include equ332.asm
```

Declare some important externals and publics.

```
XDEF START,_brkp,_brksz,_exit
XREF STKTOP,DATA,_main
```

I removed the C++ initializers. See the original start.s file for their declaration.

Define variables to track memory allocations for mbrk().

```
_brkp SECTION ram
DS.L 1 ; point to available memory
_brksz DS.L 1 ; number of available bytes
```

The reset vector will point to this code (START).

By the time we get here, A7 will have been initialized.

```
SECTION code
.STK "none" ; terminate call chain for -Og
START MOVE.L #STKTOP,A7 ; set the stack pointer
MOVE.L #0,A6 ; terminate call chain for -Og
```

Perform low-level configuration of system hardware. Configuration relies on the table at label config below.

```
tbl1: move.w #$2700,SR ; setup the status register
move.l #config,a0 ; point to start of config tbl
move.w (a0)+,d0 ; get size word
move.l (a0)+,a1 ; get destination addr
move.l (a0)+,d1 ; get data to move
cmp.w #0,d0
bne tbl2
move.b d1,(a1) ; write byte to addr
bra tbl1 ; do next
tbl2: cmp.w #1,d0 ; write a word?
bne tbl3 ; branch if not
move.w d1,(a1) ; write word to addr
bra tbl1 ; do next
tbl3: cmp.w #2,d0 ; write a long?
bne tblx ; if not, all done
move.l d1,(a1) ; write long to addr
bra tbl1 ; do next
tblx: Zero out uninitialized RAM.
```

```
ZLP: MOVE.L #'BASE(ram),A1 ; A1 = base of region ram
MOVE.L #'SIZE(ram),D0 ; D0 = size of region ram
LSR.L #2,D0 ; compute size in longs
BRA ZDBF ; enter a fast loop
ZDBF: DBF D0,ZLP ; up to 256K in inner loop
SUB.L #$10000,D0 ; rest in outer loop
BHS ZLP ; clear four bytes at a time
; Initialize other RAM from ROM.
ILP: MOVE.L #DATA,A0 ; A0 = ROM base of region data
MOVE.L #'BASE(data),A1 ; A1 = RAM base of region data
MOVE.L #'SIZE(data),D0 ; D0 = size of region data
LSR.L #2,D0 ; compute size in longs
BRA IDBF ; enter a fast loop
IDBF: MOVE.L (A0)+(A1)+ ; move four bytes at a time
DBF D0,ILP ; up to 256K in inner loop
SUB.L #$10000,D0 ; rest in outer loop
BHS ILP ; handle 2-byte C "pointers"
; Initialize memory allocator.
MOVE.L #'BASE(malloc),D0 ; address of malloc region
MOVE.L #'SIZE(malloc),D1 ; size of malloc region
.IF "ptrd"?2" SWAP D0 ; handle 2-byte C "longs"
.ENDIF
.IF "long"?2" SWAP D1
.ENDIF
MOVE.L D0,_brkp ; vars referenced by mbrk()
MOVE.L D1,_brksz
; Invoke main() with no arguments.
JSR _main ; "int" return value in D0
; Control reaches this point if control leaves main().
exit
DONE BRA DONE ; loop if main ever returns
; If your program needs standard character I/O routines, this makes
; a good place to stash them. The following routines assume that
; CPU32 is available, and rely on the monitor's TRAP mechanism.
outch output char in D0 to active port
XDEF _outch
.FDEF _outch,4
_outch move.b d0,-(a7) ; save char on stack
trap #15 ; use CPU32
dc.w $0020 ; output a char
```

# ROBOTICS . . . ROBOTICS . . . ROBOTICS . . . ROBOTICS . . . ROBOTICS

up make files for automatically compiling and assembling your projects. The assembler supports macros and relocation, and the package includes a linker (but no librarian) for creating a large project out of several smaller library files. In short, this demo kit is a godsend for the hobbyist or student on a budget.

One feature of this kit that I really like is the ability to generate absolute listings from the relocatable output files. If you've used any of the older relocating compiler suites, you know how irritating it can be to try and use a monitor to debug your code. All of the listings contain labels addressed at 0, since the linker will fix them up later, so you never know where a label or variable lies in memory. The SDS kit, however, includes a program called abs, which merges the linker information with the relocatable listings, giving you printouts with real addresses for all those variables. Mighty handy, and way cool for a free compiler.

There are a few restrictions on this system worth noting. As I said, the linker does not include a librarian, so you cannot alter the two main library modules supplied with the package, nor can you create your own object library modules. Also, each invocation of the linker supports a maximum of three different object files plus the library files, so you end up having to create large source files to stay within the three-file limit. Finally, the compiler and assembler apparently are restricted to using available memory for holding their working tables, which puts an effective, but unknown limit on the size of files you can assemble or compile. Still, if

Lou's approximation is on-target, I'll write a lot of robot code before I hit that wall.

The bottom line: Run, don't walk, to your web browser, telephone, or fax, and order a copy of the SDS Starter Kit for the 68000. Check their web site at [www.sdsi.com](http://www.sdsi.com) for full details. I have the floppy disk package, but Lou mentioned a CD-ROM version as well. If the CD-ROM version includes the user manuals, it is a must-have. Contact info is:

**Software Development Systems, Inc.**  
815 Commerce Drive, Ste. 250  
Oak Brook, IL 60521  
Voice: 708-368-0400  
Fax: 708-990-4641

## Making it work

Now comes the tricky bit. I have this first-class compiler and a first-class microcontroller; I just have to make the compiler create code that the board can run right out of reset. Those of you who have created Windows programs using tools such as Visual Basic have been able to skip over this next problem, as you have an operating system shielding you from the low-level tasks. But there are no such shields in place in robotics, and your software design has to cover everything that happens from the very first CPU clock cycle.

The reset start-up task requires that you, as the system engineer, know all you can about the microcontroller your code will run on and the runtime module your compiler will graft onto your

object file. The 68332 MCU contains a variety of extra I/O subsystems, each more complex than its 68hc11 counterpart, if there is such. Still, the general startup flow can be (grossly) simplified to the following steps.

First, initialize such system-wide elements as the MCU clock frequency and the CPU's stack pointer. Next, set up the MCU's chip-select lines so the external memory is remapped from its reset state to its final working configuration. Finally, begin executing the top-level program by jumping to the address of the function main().

The key element behind this start-up task is an assembler source file called start.s. The SDS demo kit includes a good start.s file to show you the basics, but I modified it extensively during my experimentation. I've included a copy of my current version of start.s, so you can see what is involved in setting up the 68332 after reset. Note that this is a preliminary version and will change rapidly and often as my development continues. For now, however, this file will give you a good start. Keep an eye

**As always, you can reach me at:**

**Karl Lunt**  
116 173rd St. S.W., Bothell, WA 98012  
**E-Mail:** karllunt@seanet.com  
**Web:** <http://www.seanet.com/~karllunt>

```
rts ; and leave
;
: inch get char from active port, return in D0
:     XDEF _inch
_inch
    subq.l #2,a7 ; make room on stack
    trap #15 ; use CPU32
    dc.w $0000 ; input a char
    move.b (a7)+,d0 ; put char in D0
    rts ; and leave
```

Define the system configuration table.

The following table works for the New Micros 68332 board. Change this table as needed for your hardware.

Each entry in the configuration table specifies the size of a value to write to memory, the address affected, and the data to write to it. The config implementation is based on the TINIT routine used by New Micros in their MAXForth/332 firmware. I liked their idea so much I had to use it in my system.

Each entry in the table consists of a word and two longs, in the following order:

dc.w	0, 1, or 2	; 0=byte, 1=word, 2=long
dc.l	addr	; address to change
dc.l	data	; value to write to addr

For example, to write the word \$0038 to address SCCR0 (sets baud rate to 9600 baud), you would use the following table entry:

dc.w	1	; SCCR0 (word)
dc.l	SCCR0	; set baud rate
dc.l	\$0038	; to 9600

Mark the end of the table with a size field other than 0, 1, or 2.

Note that the configuration values are written to the hardware registers in the order of appearance.

```
config:
    dc.w 1 ; 16.667MHz
    dc.l SYNCR
    dc.l $7F00
    dc.w 0 ; BME, NO WATCHDOG TIMER
    dc.l SYPCR
    dc.l 4
    dc.w 1 ; 1st rom, 128K at 0000
    dc.l CSBARBT
    dc.l $0004
    dc.w 1 ;
    dc.l CSORBT
    dc.l $7B70
    dc.w 1 ; 2nd rom, 16K at 4000
    dc.l CSBAR0
    dc.l $0042
    dc.w 1 ; ram is mapped via cs1
```

```
    dc.l CSBAR1 ; and cs2 - 1024K each
    dc.l $0007
    dc.w 1
    dc.l CSBAR2
    dc.l $0107
    dc.w 1 ; io space, 128K at f00000
    dc.l CSBAR3
    dc.l SF004
    dc.w 1 ; wait states for CS
    dc.l CSOR0
    dc.l $7B70
    dc.w 1
    dc.l CSOR1
    dc.l $7B70
    dc.w 1
    dc.l CSOR2
    dc.l $7B70
    dc.w 1
    dc.l CSOR3
    dc.l $7B70
    dc.w 1 ; sci=9600 baud
    dc.l SCCR0
    dc.l $0038
    dc.w 1 ; enable rcv and xmt
    dc.l SCCR1
    dc.l $000C
    dc.w 1 ; setup internal ram
    dc.l TRAMBAR
    dc.l $FFEB
    dc.w $ffff ; marks end of table
```

Declare the reset vector, stored in supervisor space at address 0. Address 0 holds the 32-bit address to write to A7, the stack pointer. Address 4 holds the 32-bit address to write to PC.

```
SECTION reset
DC.L STKTOP ; initial stack pointer
DC.L START ; initial execution address
```

OTHER EXCEPTION VECTORS: to supervisor data space at address 8, or 8 bytes beyond where the vector base register will point. This table is commented out because no actual interrupt routines are provided.

```
*****
SECTION vects
DC.L BUSERROR,ADRERROR ; 0x08
DC.L ILLEGAL,ZERODIV,CHK,TRAPV ; 0x10
DC.L PRIVILEGE,TRACE,EMULA,EMULF ; 0x20
DC.L RESVD,PROTO,FORMAT,UNINIT ; 0x30
DC.BL 8,RESVD ; 0x40
DC.L SPURIOUS,AUTO1,AUTO2,AUTO3 ; 0x60
DC.L AUTO4,AUTO5,AUTO6,AUTO7 ; 0x70
DC.L TRAP0,TRAP1,TRAP2,TRAP3 ; 0x80
DC.L TRAP4,TRAP5,TRAP6,TRAP7 ; 0x90
DC.L TRAP8,TRAP9,TRAP8A,TRAPB ; 0xa0
DC.L TRAPC,TRAPD,TRAPE,TRAPP ; 0xb0
DC.L FUNORD,FNEXACT,FZERODIV,FUNFLOW ; 0xc0
DC.L FOPND,FOVFLOW,FSNAN,RESVD ; 0xd0
DC.BL 8,RESVD ; 0xe0
DC.BL 192,USER ; 0x100
```

on my web site for ongoing updates to this and other 68332-related files.

Immediately after reset, the 68332 fetches the 32-bit value at address \$0 and uses it as the stack pointer (register A7). It also fetches the 32-bit value at address \$4 and uses it as the program counter (PC). The CPU sets up its internal registers and flags, then passes control to the program at the address currently in PC. Given the start.s file below, that starting point is the label START. Browse through the file, checking both the code at START and the code in the vector table, so you understand how this reset mechanism works.

Notice that the source at START follows an assembler SECTION directive that references an area called code. This SECTION directive tells the linker that subsequent object code should be placed in an area of memory named code. Later, when you run the linker to build the final executable, your linker commands must assign an address to this code section. The linker, in turn, will pull together all the various code sections, regardless of what object file they appear in, and stack them up at the designated code address. The linker will perform this same task for all the other SECTION directives it encounters. As it does so, the linker will automatically adjust the addresses of any referenced variables and labels, so the final executable file contains the correct addresses for the memory areas you have defined.

This operation is known as relocation, and lets you write a program without knowing exactly where in memory it will ultimately execute, with one small caveat. The SDS compiler will always generate code that can be successfully relinked, since that is how it was designed. The assembler, however, relies on you to make sure your code is relocatable. The linker will trip up if you try to make it relocate something that isn't relocatable, but the back-and-forth

edit, assemble, and link operations can get to be a drag. For this reason, it's usually handy to write in C rather than assembler.

At START, the code sets up some internal registers, then begins a large loop that sets up the hardware registers. The 68332 has about a billion I/O registers, some of which are vital to your program and many of which are irrelevant. But the vital ones must be set up before your program will run successfully, and which ones you need to alter will vary depending on your design. So the register set-up loop uses a table that you can customize quickly without getting bogged down in a bunch of nasty looping code and special conditions. Simply check the code further down in the file, at label config. This is a typical configuration table and should provide all the details you need for building your own table.

Next, the program prepares two areas of memory reserved by the C compiler. One area, in the section named RAM, contains all uninitialized C variables. By convention, these variables must all contain 0 following reset, and the short loop around label ZLP makes sure this task gets done. Immediately after this loop lies a second loop with a similar function. The code around the label ILP takes care of those variables that must be filled with preassigned values following reset. Notice how the code copies values from the section named DATA, which lies in ROM, to the section named data, which lies in RAM. Again, the command options you specify to the linker assigns these addresses so the linker gets everything sorted out properly.

Finally, everything is set up and the CPU is ready to run your top-level program. It does this by executing a JSR instruction to the address \_main, which is where the compiler puts the start of your main() function. Now your top-level code takes

over, causing your robot to roll forward, find the candle, and claim first prize. By convention, control should never leave the main() function in an embedded control program such as this. If it should, however, the tight loop at label \_exit will snag the CPU, preventing it from running away and executing trash.

Every C program you write must include the object file created by assembling the file start.s or something similar. Therefore, your work with the SDS compiler package is immediately limited to just two other files, as the third and final file you get will be start.o, the object file for start.s. Note that I have included a pair of character I/O routines in my start.s. These provide the low-level code for exchanging characters via the 68332's SCI. In this version of start.s, I've used a TRAP instruction that invokes the CPU32BUG's character I/O subfunctions. In later versions of start.s — which will run when the CPU32BUG monitor has been removed — I will include code that performs these I/O operations directly.

#### That's a wrap

This completes the first phase of my robot design. I realize there isn't much in the way of hardware or electronics here, but I foresee software as the biggest hurdle, and I want to get a quick start on it. I will keep you informed in upcoming articles as to my progress on this project. Bear in mind that this design is evolving as I write these articles, so elements of the design will change from month to month. Given the time lag between my writing and your reading, I will always be about six weeks ahead of what you see here. And you won't even see the final project before the contest runs. But it should prove interesting, and I hope you'll stay tuned. NV

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**Seeking A Solar Panel**

**Q.** I've enjoyed your writings over the years, but alas, I missed all but the last installment of the Nuts & Volts Solar Workshop, and was sorry to see that it's now gone. However, I need help on photovoltaics. A few years ago, I bought a 15-18V (800 mA) panel and used it in a project. Now I find myself in need of another panel, but can't remember the name (or location) of the company. I know it's not much to go on, but I'd sure appreciate it if you suggest a few companies to me. This time my needs are for about 10-13 volts, to be regulated down to 6.5 volts at 500 mA.

**Jeff Kerner  
via Internet**

**A.** Sure, here's a short list of companies that I trust. For a more comprehensive list, download the SOLAR.TXT file from our Web site. By the way (BTW), the N&V Solar Workshop isn't dead. It'll resurface from time to time as the need arises.

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<http://www.indra.com/jade-mtn/pv.html>**Sierra Solar Systems**

800-517-6527

E-Mail: [solarjon@oro.net](mailto:solarjon@oro.net)**Solar Electric Inc.**

800-842-5678

<http://www.solarelectricinc.com>**30-Pin To 72-Pin SIMMs Converter**

**Q.** I have a dozen or so 30-pin SIMMs that I want to use in my PC, which has four 72-pin SIMMs slots. I was thinking of making a circuit board that would accept all these SIMMs that I'd plug into a single 72-pin slot, but I don't know the pinouts or the schematic. I'm good with electronics, so I know I can do this.

**Shirley Brown  
via Internet**

**A.** I suggest buying a SIMMs 30-pin-to-72-pin converter card instead of trying to make your own adapter. That's because of the speed at which these devices operate. Unless you're extremely careful with wire length and termination, you'll get ringing and noise that'll cause your PC to crash. You can buy these converters from Jameco (800-831-4242; <http://www.jameco.com>) for under \$30.00.

**DOS Hidden Files**

**Q.** In your response to "COMMAND.COM, Where Are You?" you advised to simply recopy COMMAND.COM to the C:\ root directory. As I remember it,

there are two hidden files, too, that have to be located at the very beginning of any bootable disk. Simply copying them to the disk won't necessarily put them where they belong because that space could be occupied by another file. Am I wrong, or has DOS evolved to the point where it's smart enough to make space for these files?

**Jerry P. Franklin  
via Internet**

**A.** No, you're absolutely right. The two hidden files, MSDOS.SYS and IO.SYS, have to be located at the very beginning of a bootable disk. And no, DOS isn't smart enough to make room on the platter for these two critical files if the area is occupied by another file. They have to be put there using the Format command, which wipes the disk clean of all data. If you want to upgrade the DOS on an already formatted, bootable disk, though, you can use the SYS command. This command replaces the older hidden files with the new version and copies the new COMMAND.COM in the root directory.

**Open, Sez Me**

**Q.** I want to make a garage door opener for the garage in our building. The building charges \$30.00 a month for the remote, and if I knew the right frequency I could build my own. However, I don't have a frequency counter. Do you know what the frequencies are?

**Alexander Belenky  
via Internet**

**A.** Unfortunately, just knowing the right frequency isn't enough. You need the digital code, too — the code that tells the door that it's you and not a stray radio signal that's trying to open it, and that I surely can't provide.

**MAILBAG****Mr. Byers:**

While I agree with most of what you said regarding phone line characteristics, I would most emphatically discourage anyone from trying to use the phone line for anything but what it was intended. Uses such as described by Mr. Rothfus are some of the reasons the phone companies fought for years against foreign attachments on the line, and why for years, type-accepted couplers had to be used to interface "foreign" devices to the phone system — to protect the network from damage. I would like to stress the fact that when the "trip current" point is exceeded, indicating an off-hook condition, which is caused by some reason other than making a phone call, the central office equipment senses this, and eventually you will incur the wrath of the phone company. You can get into trouble messing with the phone system.

**Bob Roehrig K9EUI  
via Internet**

**Response:**

I agree wholeheartedly! Real damage can be done if you don't know what you're doing. Moreover, there are legal repercussions for the misuse of a public utility. If you notice the intro to my answer, I recommended a small solar panel instead. On the other hand, many commercial products tap into the phone company's power, which can lead one to believe there's a free lunch out there. So if a person insists on tapping into this free-

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FNB-38 9.6v @ 600 mAh

ICOM-W21AT/2GX

BP-157 7.2v @ 900 mAh

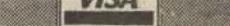
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power, too, it's better to have a full knowledge of what they're working with than no knowledge at all. That's why I opted to go with the bridge rectifier buffered with a voltage regulator. It provides the best isolation, and is standard fare on most commercial phone-powered equipment.

**TJ Byers**  
Q & A Editor

Mr. Byers:

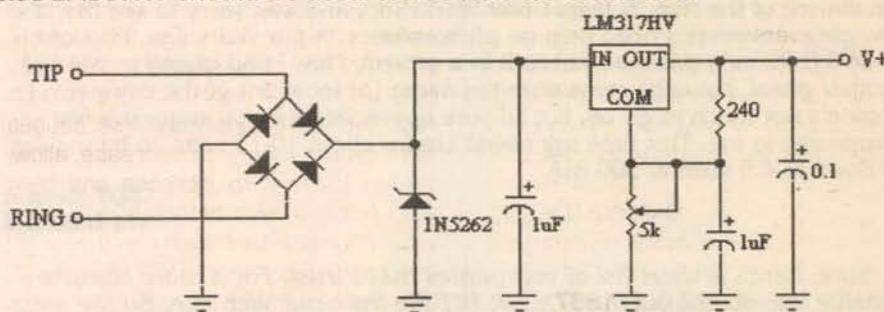
In your Sept. '97 issue, page 72 (Electronics Q & A), you show a circuit using a 78Lxx regulator to derive low voltage from a phone line. The 78Lxx series has a maximum input voltage rating of 35 volts. With the tip-to-ring voltage at times exceeding 50 volts, the regulator will blow. I suggest using an LM317HV from National Semiconductor instead, which has a maximum input voltage rating of 60 volts.

**Lada Leitner**  
via Internet

Response:

Actually, I tested this circuit using an LM78L12 with a 20 mA load, and had no problems. It's because the 1 uF capacitor has to charge first, which gives the regulator time to turn on and load the phone line before it

exceeds the maximum input voltage. But your point is well taken. Under no-load conditions, the regulator is at risk, in which case, the more-expensive LM317HV should be used. Here's how it's connected.



An item I forgot in the original circuit was a ringer snubber that would prevent the ring voltage (which can exceed 100 volts) from destroying the IC. I've added it to this design, and suggest that readers who want to use the 78xxx series do the same (use a IN5289, though).

**TJ Byers**  
Q & A Editor

## TECH FORUM

Continued from page 79

time. This takes care of the clock and memory settings. Pin 2 - +13.8V from ignition switch. Shuts off when ignition off, main power to radio. Pin 3 - Power to front panel lamps from dimmer switch on dash. Dims lamps with dimmer control. Pin 4 - Power from side marker lamps. Dims fluorescent display during park. Pin 5 - Right channel front and rear speaker common (same as black connector, pin 1). Pin 6 - Left channel front and rear speaker common (same as black connector, pin 2). Pin 7 - Audio muting [used as test point].

BLACK connector [pin 1 is the one with the bump] is mostly for speaker outputs:

Pin 1 - Right channel front and rear speaker common. Pin 2 - Left channel front and rear speaker common. Pin 3 - Right front speaker hot. Pin 4 - Left front speaker hot. Pin 5 - Right rear speaker hot. Pin 6 - Left rear speaker hot. Pin 7 - Switched +13.8V operates power antenna when radio turned on.

NOTE: There are no grounds on either connector. Ground has to be applied to the chassis. Ground could come through the antenna coax shield, however, it is not wise to depend on this. If you do repair work on these radios, be aware we have available a "house number" to "real

world" number cross list for the ICs used in these, as well as other brand auto radios. This can save a lot of money, as the mark-up on "house" number chips can be huge!

Bomarc Services  
Casper, WY

### ANSWER TO #10977 OCT. 1997

The answer to your question is yes. The problem is, what do you know about precision optics and high-speed timing? If you are comfortable with beam splitters and high-speed counters then what you want should be no problem. If you have these skills then I would first suggest that you purchase one of the many surplus range finders that are becoming available through many surplus dealers and repair it, and/or modify it for finer detail.

Doing it this way saves you the time and effort of shopping for what would otherwise be a "very expensive shopping spree" and it allows you to learn the ways of the past, mistakes included.

If you intend to start from scratch, then you do have a uphill task in front of you in which you will need to learn and familiarize yourself with many factors including precision optical alignment and phase alignment.

There are several ways to achieve "phase or coherent" timing. [Count] and again, what you know is everything. Accuracy can be down to less than what you described, if the math is correct.

The precision of these numbers today can be realized with the readily available GHz counters, consequently your project is possible, but you will need to know quite a bit about optics and electronics if you are to succeed.

Chris  
Bieber, CA

### ANSWER TO #109716 OCT. 1997

I'll discuss two main methods. The first involves some kind of sensor, i.e., a PIR or microwave motion detector, pressure switch, or glass-break detector, that is connected to either a contact closure relay or some other "bridge" which interprets an alarm condition and activates the appropriate device [VCR/Alarm].

The second, is a true "video" motion detector per se. Older video motion detection consisted of an actual light sensing device mounted on the receiving monitor from the camera in question. It was placed in the area of the monitor that consisted with the critical area that the camera was "seeing." Like a door, for example. When someone passed through that area, the light

value of the screen would change, thus would the light sensor and trip the alarm.

This method has evolved quite a bit, and sensors are no longer needed physically on the monitor, as the actual video signal is scanned. Several areas and cameras can be monitored at once.

Ryan Gamache  
wild-hair@juno.com

### ANSWER TO #10975 - OCT. 1997

Programming a screen saver in MS-DOS is a daunting task for a beginner (or an expert, for that matter ...). Assuming you want to be able to detect inactivity over a period of time, this will take a great deal of knowledge concerning interrupts, service routines, and such. A relatively simple screen blanking program could be written in assembly language that monitors interrupt 08h [for keyboard activity] and interrupt 09h [so it can activate after a period of time]. Then, upon triggering, it can turn off the video refresh until another key is pressed. If you want to draw your own graphics [as most screen savers do] then you will have to save the video state, then restore it before returning control to the program.

If you want to simply make a program that can be activated on the com-

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## TECH FORUM

mand line, then it is very easy. You can use any programming language that has a PC version. [For the beginner, I would recommend Quick BASIC.] Since you already have knowledge of BASIC, the on-line help should have all the information you need to get up to speed.

Chuck Homic  
Ballston Spa, NY  
chuck@visions.com

### ANSWER TO #10972 OCT. 1997

You are the victim of what is called "thermal runaway" in solid-state electronics. What you first need to know is that LEDs are light-emitting-diodes, not incandescent lamps!

LEDs don't have filaments, just junctions as in any other type of diode. The rating of 100 mA is the absolute maximum current useable before damage occurs. The 1.2-volt rating is the typical forward voltage drop across the junction, held at 25°C, with 100 mA flowing through it.

The forward current is an exponential function of the forward bias voltage. If the voltage increases by about 0.1 volts, the current increases by one decade! Thus, it is much safer to use a bias current to illuminate the LEDs. Also complicating matters. As the junction temperature increases, the for-

ward voltage decreases.

If you apply 12 volts directly to a series string of 10 LEDs, the current will start out at somewhere near 100 mA, which is enough current to self-heat the diode junctions. This causes the forward voltage to decrease, allowing the current to increase and heat the junctions even hotter, allowing the voltage to decrease even more. Sooner or later, one or more of the devices fail, with the remainder damaged!

Try this instead: power a series string of five LEDs in series with a 68 ohm, 1W resistor, using a 12-volt supply. This will limit the current to about 90 mA, a somewhat safe region for the LEDs. A much safer current would be about 50 mA, which you could obtain using a 120 ohm, 1/2W resistor instead of the 68-ohm unit.

You can parallel as many of these strings as you require on the same 12-volt supply. Simply add up the currents for each string to figure the total required from your supply. If you require further information on the subject of LEDs, please refer to my article, "Semiconductor Diode Guidebook" in the June '97 issue of *Popular Electronics Magazine*.

Skip Campisi  
Bound Brook, NJ

### ANSWER TO #109721 OCT. 1997

Since the author did not list the unique boot-up sequence of numbers that appears on the bottom of the screen from his BIOS ID, it is very difficult to answer his question. I have, however, found the SIS 471 chipset he mentioned.

The Award BIOS ID appears at the bottom of the screen after power on, during memory count up. The PAUSE key should work at that point, allowing you to write down the BIOS number, the BIOS date, and the version. Then compare those numbers with the list below, the manufacturer of the motherboard can be located. Further information can be found at the website listed below and at <http://www.motherboards.org/>

The AWARD BIOS number page can be located at the following website <http://ping4.ping.be/bios/numbers.shtml> and the following information was located there for the SIS 471 and 486-based motherboards.

SIS 471 B/E Chipset (486 based M/B) and SIS 85C471B/E/G Chipset (486 based M/B)

2C418C30: Chaintech 486SLB / Chipset: SIS-85C471  
2C418F21-00: Genoa (model: ???) or firenze 486 VL. VII (or Freetech?)  
2C418F30-00: ??? (Full Yes?)  
2C418G01-00: Gigabyte GA-486VS  
2C418G30: OPTI 895 GREEN PC VL/ISA-PB486P3  
2C418S21: Soyo 25M/N/P  
2C403U0Z-00: Uniboard KS-TG919 Ver:3.1 (Chipset SIS-471B/D-B 01/17/96???)  
2C419000-00: ???  
2C419521-00: ??? 03/08/95-SIS-85C471B/E/G  
2C419523: ??? 09/26/94-SIS-85C471B/E/G  
2C419A12: Abit (model: ???)  
2C419ADD: ???  
2C419C21: Chicony CH-471B  
2C419C21-08: Chicony C471  
2C419C31-00: Chaintech (model: ???)  
2C419E30-00: EFA 4DMS-HL3G  
2C419F20-01: Freetech (model: ???) or Genoa 486VLGX4  
2C419F21-00: Freetech (model: ???)  
2C419F30-00: Full Yes (model: ???)  
2C419G01: Gigabyte GA-486VF (Rev. BB)  
2C419G30: Gemlight GMB-486SG  
2C419M92-00: MLE (model: ???)  
2C419M93: MLE (model: ???)  
2C419R01: M-Technology (Mtech) R407  
2C419P82-00: Azza (model: ???)  
2C419S21-00: Soyo (model: ???) (E2.1 08/01/94)  
2C419S22: Soyo (model: ???)  
02/08/94 SIS-85C471-486SV2G-80: ???  
10/11/94-SIS-85C471-486-SV2G00: (Chipset: SIS 85C471), Model: VL/I-486SVGOX4 Manuf: ???

Arthur Hazboun

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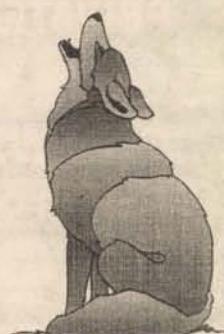
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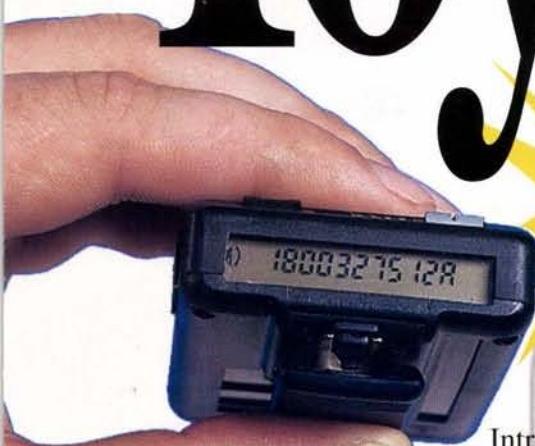


# Toyz for Test

Optoelectronics Presents

**Techtoyz™**

**Micro DTMF Decoder**



**\$99**

Introducing the all new Techtoyz Micro DTMF Decoder. The Micro DTMF Decoder, housed in a pager style case, is ideal for portable, hands free operation. With its built-in microphone, DTMF tones are automatically decoded from the signal source of tape recorders, receivers, two-way radios, etc... Tones are displayed on the Micro Decoder's 12 digit LCD display and automatically stored in the 2000 character non-volatile memory for review. The Micro Decoder has a built-in audio input allowing for easy connection to any receiver's speaker output. The all new Micro DTMF Decoder from Optoelectronics; The Best in Test.

Patent No. 5,471,408

## FEATURES

- Pager Style Case with belt clip
- 12 Character LCD display
- Internal microphone for radio speaker or tape recorder
- Line audio input jack for direct connection
- 2000 character Non-Volatile memory
- 200 hour operation from single AA alkaline battery
- Auto blank insert function after 2 second delay
- Left and Right Scroll in recall data mode
- Auto low battery shutdown and data save

**Micro Counter**

Optoelectronics pioneered the market of high quality and performance in a small size with our revolutionary Handi-counter® line of portable, handheld frequency counters. We are again ready to pioneer the market by proudly introducing the latest in technology for frequency counters, the Techtoyz Micro-Counter. The new Techtoyz Micro-Counter. The smallest frequency counter in the world, housed in a pager style case, yet still featuring the quality and performance you would expect from an Optoelectronics product.

## FEATURES

- Pager Style Case with belt clip
- 12 Character LCD display
- 10MHz - 1.2GHz range
- Four modes: Normal, Filter, Capture, Recall
- 10 -12 Hr. operation from AA Alkaline battery
- Sensitivity: <5mV @ 150MHz
- 3 selectable gate times for increased resolution
- Stores three frequencies in memory

Performs best when used with the TMC-100 rubber duck antenna (\$9.).



Patent No. 5,471,408

**\$99**

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Coming Soon  
Micro RF Detector

# BASIC Stamp® computers

Tiny computers run PBASIC programs

BASIC Stamps answer the request for small, low-cost, easily programmable computers. BASIC Stamps are programmed in Parallax BASIC (PBASIC), a simple language with powerful I/O instructions. BASIC Stamps have their own PBASIC interpreter, non-volatile EEPROM, and 5-volt regulator. Because of their reliability and ease of programming, BASIC Stamps are the microcontroller of choice for hobby projects and industrial control.



Mechanical insect controlled by BASIC Stamp

Parallax's United Kingdom distributor Milford Instruments ([www.milinst.demon.co.uk](http://www.milinst.demon.co.uk)) uses the BASIC Stamp I to control servos, LEDs and antennae switches in their BASIC Stamp Bug kit. The BASIC Stamp Bug was a popular guest in our booth at the June COMDEX show in Atlanta, Georgia, and now finds its way into our regular product line. Call for pricing and availability of this little beast.



Plastic extrusion machine industrial application

Fisher Automation of Whitestone, New York uses BASIC Stamps in their plastic extrusion machines to sense the appropriate time to start a cut cycle and sequence several pneumatic valves. Fisher Automation reports that "the BASIC Stamp has proven extremely reliable in our applications, running 24 hours per day, seven days a week, and performing up to 70 cuts per minute."

## BASIC Stamp® modules

### BS1-IC Module

8 I/O lines  
800 PBASIC instructions max.  
2000 instructions/sec.  
2400 baud serial I/O  
14-pin SIP module

Familiar PBASIC language with I/O instructions including BUTTON, HIGH, INPUT, LOW, OUTPUT, POT, PULSIN, PULSOUT, DEBUG, PWM, REVERSE, SERIN, SEROUT, SOUND, and TOGGLE.



\$34

### BS2-IC Module

16 I/O lines  
500 PBASIC instructions max.  
4000 instructions/sec.  
50k baud serial I/O  
24-pin DIP module

Similar language as BS1-IC, plus DTMFFPUT, FREQOUT, SHIFTIN and SHIFTOUT, XOUT (X-10 powerline control), etc. I/O functions common to both modules have a higher resolution on the BS2-IC, due to its faster clock speed. Larger EEPROM, high speed, and diversity of instructions make the BS2-IC our most popular product.



\$49

## BASIC Stamp Starter Kits

BASIC Stamp I Starter Kit (part #27205) \$99

BASIC Stamp II Starter Kit (part #27203) \$149

BASIC Stamp Starter Kits include the BS1-IC or BS2-IC modules shown above, carrier board with prototype area and 9-volt battery clip, manual, application notes, and software. Free technical support is also included.



BASIC Stamp II Starter Kit shown with BS2-IC module on carrier board

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